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One potential solution to the problem of battery life in mobile computing is the use of solar energy to power mobile devices. Solar energy is a clean and renewable source of energy that can be used to charge mobile devices and extend the battery life of the device. Solar panels can be installed on the device to capture and store solar energy, which can then be used to provide power to the device. This can help to reduce the amount of energy consumed by the device, allowing the device to operate for longer periods of time on a single charge.

I. Introduction (Kin):

Mobile devices have become an essential part of many people’s daily live. They rely on their phone for various activities such as communication, entertainment, navigation, and productivity. Limited battery life leads to a loss of productivity if a user is unable to complete important tasks due to a dead battery. On the other hand, travelers and people who are on-the-go might not easily have access to a power source to recharge their phone. Smartphones in particular, have multiple sensors and wireless interfaces that drain battery quickly, and thus, reducing the operational time [1].

The proposed solution is to develop a compact and affordable solar-powered mobile device that can be charged using a small solar panel made of high-efficiency solar cells. The device is designed with low-power components to minimize its energy consumption to ensure efficient charging. It is designed to supplement the battery life with solar power that is suitable for use in areas with limited sunlight. The 5-year plan involves research, development, testing, refinement, and launching with a focus on targeting environmentally conscious consumers and users in areas with limited access to electricity.

II. Literature Review (Michael Blumberg)

Research into solar powered charging solutions has been conducted for many years, with the aim of finding reliable and efficient ways of powering mobile phones and other devices. A study by the Chinese Academy of Sciences (L. Chen et al., 2018)[2] found that a solar powered charging system could reduce charging time and provide enough energy to last for several hours, even in low light conditions. Additionally, Popular Mechanics (2019)[3] found that a solar powered phone charger could fit into a pocket or bag, and provide sufficient power to charge a smartphone in a few hours. The design of a solar charging case for mobile phones is also beneficial, as it can be waterproof, dustproof and compatible with a variety of devices.

Solar powered mobile phone charging has several advantages, including cost savings, environmental friendliness and the potential for use in remote locations. However, there are still several limitations regarding the amount of energy collected, which can be affected by factors such as weather and angle of placement. Additionally, the process of collecting and storing the solar energy can be slow, making it impractical for those needing to charge their phone in a hurry.

A gap in the research is the need for an improved way of storing the solar energy. Currently, the process of collecting and storing the solar energy can be slow and inefficient, making it impractical for those needing to charge their phone in a hurry. Additionally, the amount of energy that can be collected through the display of the phone is limited and can be affected by factors such as weather conditions and the angle at which the phone is placed. Therefore, further research and development is needed to improve the efficiency and speed of the process for collecting and storing solar energy.

III. Problem Statement (Shaohua)

The battery life of mobile devices is limited, and users often find themselves running out of battery power when they need their devices the most. The main issue with mobile computing battery life is that it is a finite resource that can only be extended to a certain extent. Manufacturers have attempted to improve battery life by increasing the capacity of batteries, optimizing software, and implementing power-saving features. However, these efforts are not always enough to satisfy the demands of users who require their devices to remain operational for extended periods.

The problem of mobile computing battery life is critical for user experience and environmental concerns. Limited battery life can frustrate users, affect productivity, and lead to a poor overall experience. With the increase in the demand and use of smartphones, giving rise to increased data services, there is increased demand for energy to power the devices. Increase in energy consumption in wireless networks directly leads to increase in greenhouse gas emission. This has been recognized as a big threat to the environment.

The problem of mobile computing battery life has significant implications for both society and industry. From the productivity and efficiency aspect, longer battery life can increase productivity and efficiency by enabling users to use their devices for extended periods without interruption, since mobile devices have become an essential tool for productivity and efficiency. From the economic impacts aspect, longer battery life can lead to increased device usage, resulting in higher revenue for manufacturers and developers of mobile applications. From the environmental impact aspect, improving battery life can help reduce the number of batteries produced and disposed of, leading to a positive impact on the environment.

IV. Proposed Solution (Song/Sean):

The proposed solution is a solar-powered mobile computing device that uses photovoltaic cells to convert sunlight into electricity, which can be used to charge the device's battery. The device will be equipped with a small solar panel that can be folded out from the back of the device, allowing it to collect sunlight during the day. Here is a visual demonstration of the proposed device.

The solar panel is made of high-efficiency solar cells, the device also features a low-power processor, optimized software, and other power-saving components, allowing it to function efficiently and make the most of the solar power it collects.

Based on general guidance, a small solar panel of around 10 square centimeters generates around 1 watt of power in direct sunlight. Under optimal conditions, it takes around 10-12 hours of sunlight to fully charge a smartphone battery. To maximize the amount of sunlight collected, the solar panel will be made with high-efficiency solar cells that can convert a higher percentage of sunlight into electricity than traditional solar cells. Additionally, the device will be designed with low-power components to minimize its energy consumption, ensuring that the battery is charged efficiently and quickly.
While there are existing solar-powered mobile computing devices on the market, many of them are either too expensive, too bulky, or too inefficient to be practical for

everyday use. There are existing solutions that require people to connect their mobile devices into a power bank which becomes inconvenient [4]. The proposed solution is different from existing solutions in that it is designed to be compact, efficient, and affordable, making it accessible to a wider range of users. Additionally, many existing solar-powered mobile computing devices are designed to function solely on solar power, which can limit their usability in areas with limited sunlight. The proposed solution, on the other hand, is designed to supplement the device's battery life with solar power, allowing it to be used even in areas with limited sunlight. Here is an overall comparison on efficiency of proposed solutions and existing solutions.

Efficiency Metric	Proposed Solution	Existing Solutions
Solar Panel Efficiency	High-efficiency solar cells could be used to convert more sunlight into electricity.	Efficiency of existing solutions may vary depending on the type of solar cells used. Some existing solutions may use less efficient solar panels, resulting in a slower charging process.
Power Consumption	Low-power components and optimized software could minimize the device's energy consumption, ensuring that solar power is used as efficiently as possible.	Existing solutions may use higher power components, resulting in a faster battery drain and a shorter battery life.
Usability in Different Conditions	The proposed solution could supplement its battery life with solar power, making it functional even in areas with limited sunlight.	Some existing solutions may rely solely on solar power, limiting their usability in areas with limited sunlight or on cloudy days.

The proposed solution is technically sound as it is compared to already existing solutions. Solar-powered mobile computing devices are already in use and have been proven to be effective in certain settings based on environmental factors. Solar powered mechanisms promote sustainable energy usage and reduce carbon emissions. They also support potential disaster relief situations when electricity is limited as they can harness sunlight energy [5]. The use of high-efficiency solar cells and low-power components will help to ensure that the device is able to charge efficiently and quickly, while also minimizing its energy consumption. However, it is important to note that the amount of sunlight available will still impact the device's battery life, and the solar panel may not be able to provide a significant amount of charge on cloudy days or in areas with limited sunlight.

V. Execution Plan - (Hasanat/Yan)

In this section, we will address the implementation of the proposed solution. Specifically, we will present a Five-Year Plan for the successful execution of the proposed solution, outlining key objectives and strategies for achieving them. In addition, we will identify milestones that will be used to measure progress and track the success of the project, with specific deliverables defined to indicate the completion of each milestone. Finally, we will address potential challenges that may arise during the execution of the project and provide mitigation strategies to address these challenges and ensure the successful implementation of the proposed solution.

A. Five-year plan for executing the proposed solution

Over the next five years, our proposed solution involves the development and implementation of a solar energy system to power mobile devices and solve the problem of battery life. As figure 1 shows, the project will be divided into four phases, including Research and Development, Prototype Development, Pilot Testing, and Commercial Deployment.

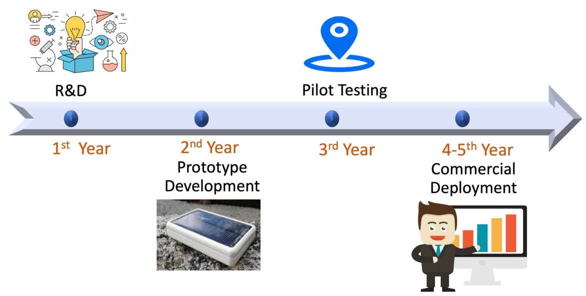

Figure 2 Five Year Plan

In the first year, we will conduct extensive research on solar power technologies and evaluate their feasibility for integration into mobile devices. This phase will involve selecting the most suitable solar panel and energy storage technologies for mobile devices. Additionally, research and development efforts will continue throughout the project to achieve continued improvement.

In the second year, we will develop and test multiple prototypes of the solar power system to power mobile devices. These prototypes will be designed to work with a wide range of mobile devices, including smartphones, tablets, and wearables.

In the third year, we will conduct pilot testing of the solar-powered mobile devices in various environments and scenarios, including both indoor and outdoor usage. This phase will be used to evaluate the performance of the solar power system and identify any areas for improvement.

Based on the results of the pilot testing, we will refine the design and manufacturing process of the solar-powered mobile devices and launch them in the market in the fourth year. This phase will involve establishing partnerships with device manufacturers and suppliers, as well as marketing and distribution channels. Furthermore, we will develop a manufacturing plan and distribution channels for the solar-powered mobile device chargers and a marketing and sales plan to promote them to potential customers.

B. Milestones for measuring progress, including specific deliverables

To measure the progress of the project, we will establish milestones and deliverables as follows:

In the first year, we aim to complete research on solar power technologies for mobile devices, with a technical report on the evaluation of various solar panel and energy storage technologies as the deliverable.

In the second year, the completion of the first prototype of the solar-powered mobile device will be the milestone, with the technical specifications and design of the prototype as the deliverable.

The successful completion of pilot testing in a range of environments and scenarios will be the milestone in the third year, with a performance report of the solar-powered mobile devices in different usage scenarios as the deliverable.

In the final year, the successful launch of the solar-powered mobile devices in the market will be the milestone, with a sales report and customer feedback on the solar-powered mobile devices as the deliverable.

C. Potential challenges and mitigation strategies

There are several potential challenges that we may face during the execution of the proposed solution, including:

- Technical challenges related to the integration of solar power technologies into mobile devices. We will establish a team of experts in solar power and mobile devices to address any technical challenges.
- Customer adoption and acceptance of the solar-powered mobile devices. We will conduct extensive marketing and awareness campaigns to educate customers on the benefits of solar-powered mobile devices.
- Cost and affordability of the solar-powered mobile devices. Solar-powered mobile device chargers may be more expensive than traditional battery-powered chargers, making them less accessible to low-income users. We will work with device manufacturers and suppliers to optimize the manufacturing process and reduce the cost of production. In addition, we will continuously reduce the cost of the solar-powered mobile device chargers through technological advancements and economies of scale.
- Environmental Factors: The availability of sunlight may be limited in certain areas, making it difficult to use solar-powered mobile device chargers. We will develop solar-powered mobile device chargers with larger and more efficient solar panels that can better handle limited sunlight.
- Regulatory and policy-related challenges related to the use of solar power in mobile devices. We will

work with relevant government agencies and policymakers to ensure compliance with regulations and address any policy- related challenges.

VI. Conclusion - (Rong)

A. Summary of the problem and proposed solution

In summary, the use of solar energy to power mobile devices is an exciting area of research with several potential future directions, such as improving the efficiency of solar panels, developing new power management techniques, exploring alternative energy sources, addressing environmental impacts, and developing new applications and use cases. These research efforts can help make solar-powered mobile devices more feasible and effective in the future.

The solution to the problem of battery life in mobile computing is not limited to the use of solar energy to power mobile devices, as there are various approaches that can be used to address this issue. However, the use of solar energy can be a promising solution as it offers a renewable and sustainable source of energy.

The basic idea is to be equipped with a small solar panel that uses photovoltaic cells can be folded out from the back of the device, which can convert solar energy into electrical energy that can be used to power the devices or recharge the batteries. Solar-powered mobile devices can help reduce the dependency on traditional power sources and extend the battery life of the devices, especially when used in outdoor settings where access to electrical outlets is limited.

However, the effectiveness of this solution and five year plan for executing the proposed solution depends on various factors, such as the size and efficiency of the solar panels, the amount of sunlight available, and the power requirements of the devices. The cost and feasibility of integrating solar panels into mobile devices should also be considered.

Therefore, while solar energy is a promising solution, it is not a one-size-fits-all solution, and other approaches such as energy-efficient hardware and software design, intelligent power management, and the use of alternative energy sources, such as kinetic or thermal energy, can also be explored to address the problem of battery life in mobile computing.

B. Significance and feasibility of the proposed solution.

The use of solar energy to power mobile devices can have several significant benefits. Solar energy is a renewable and sustainable source of energy. Unlike traditional power sources, such as fossil fuels, solar energy does not deplete over time, and it has a minimal environmental impact. By using solar energy, the battery life of mobile devices can be extended. Solar-powered mobile devices can recharge their batteries during the day, even when in use, which can help reduce the dependence on traditional power sources and extend the life of the device. Solar energy is free, and once the solar panels are installed, there are no additional costs associated with using solar energy to power mobile devices. This can help users save money in the long run and make the devices more affordable. Solar-powered mobile devices can be used in areas where access to traditional power sources is limited or unavailable. This can be especially useful in developing countries or during natural disasters, where power outages are common.

However, the feasibility of using solar energy to power mobile devices depends on several factors. The size and efficiency of the solar panels used to power mobile devices can significantly impact their feasibility. The solar panels must be small and lightweight enough to be integrated into mobile devices, and they must be efficient enough to generate sufficient power to meet the energy requirements of the device. The availability of sunlight can also impact the feasibility of using solar energy to power mobile devices. In areas with limited sunlight, such as during the winter or in heavily shaded areas, solar panels may not generate enough power to sustain the device. The cost of installing solar panels on mobile devices can be a significant barrier to their feasibility. While the cost of solar panels has decreased in recent years, it can still be prohibitively expensive for some users. Finally, not all mobile devices are compatible with solar panels. The device must be designed to integrate with solar panels and have the necessary hardware and software to support solar power.

Therefore, while the use of solar energy to power mobile devices can have significant benefits, its feasibility depends on several factors, such as the size and efficiency of solar panels, availability of sunlight, cost, and compatibility with the device.

C. Future research directions

The use of solar energy to power mobile devices is an active area of research, and there are several future research directions that can be explored to further improve the feasibility and effectiveness of this approach. Some potential research directions include:

1. Improving the Efficiency of Solar Panels: The efficiency of solar panels is a critical factor in determining the feasibility of solar-powered mobile devices. Researchers can explore new materials and designs to improve the efficiency of solar panels, such as the use of thin-film solar cells or perovskite solar cells[6].

2. Developing New Power Management Techniques: Power management techniques can help optimize the use of solar energy in mobile devices. Researchers can explore new software and hardware designs to improve the energy efficiency of mobile devices, such as adaptive voltage scaling or dynamic frequency scaling.

3. Exploring Alternative Energy Sources: While solar energy is a promising solution, other alternative energy sources, such as kinetic or thermal energy, can also be explored to power mobile devices. Researchers can develop new technologies that can convert kinetic or thermal energy into electrical energy to power mobile devices.

4. Addressing Environmental Impacts: The use of solar energy has minimal environmental impact, but the production and disposal of solar panels can have environmental implications. Researchers can explore new production and recycling

techniques to minimize the environmental impact of solar panels.

5. Developing New Applications and Use Cases: Finally, researchers can explore new applications and use cases for solar-powered mobile devices. For example, solar-powered mobile devices can be used in remote sensing, environmental monitoring, or disaster response, where traditional power sources are unavailable or unreliable.

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