Solar Powered Mobile Phone Charger for Farmers

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ABSTRACT

Mobile phones now a days are the important communication tools in our day to day life. Use of mobile phones are increasing day by day in Bangladesh. Now a days, rickshaw puller, day laborer and farmers are using mobile phones. Since these types of peoples stay outdoor for a long time, it is difficult for them to charge their mobile phones when they are out for work. In this paper, a solar powered mobile phone charger has been presented which is designed and implemented for the farmers who usually work directly under the sun. The small solar panels are placed on the cap usually weared by the farmers. Here, 30 Polycrystalline silicon color solar cells have been used having a maximum power capacity of 0.172 W and maximum voltage of 0.512 V of each cell. First, we have connected five cells in series to make a panel then this type of six panels were connected in parallel to increase the current of charging. A Boost converter has been used to boost the voltage level coming from the solar panels to a usable voltage for charging. After mounting the panel on the cap, we have used a bluetooth based circuit to take the voltage and current data of the charger remotely. Putting the cap in sunlight and using a mobile phone having a battery capacity of 900 mAh we have successfully charged it from 7% to 67% in about 105 minutes during 10:25 am to 12:10 pm. This is an indication that a farmer can use it during his work time in the field.

1. INTRODUCTION

Technology has spread out all over the world. Now we are more dependent on the modern technology. We are using different types of technology in communication sector, but mobile is the more user friendly than any others technology. Mobile phones are among the most popular wireless communication tools in almost all the countries throughout the world. Over 6.8 billion peoples in the world uses cellphones for their different purposes [1] and the number is growing fast. However, with moderate usage the average lifetime of a cellphone battery is only around 8-12 hours. This becomes very inconvenient for people who works outdoors for their livelihood. People need to carry a wall phone charger and look for a power source in order to charge their mobile phones. At present, people are going to different places for their livelihood. When people go to the cities, markets, offices etc., they can get a place where they can charge their mobile phone. But when a village farmer goes to their field, there is no opportunity for mobile charging. But they need to use mobile phone for different purposes.

To solve the mobile phone battery charging problem renewable energy sources especially solar power are used to provide energy for the device battery. Tiny solar panels can be placed in any open space on the earth. Other than the conventional sources of electrical energy which produce a lot of CO_2 the advantage of using solar cells are that they are portable and the CO_2 emission is almost zero. The portable solar-powered phone charger is a device that uses sunlight to charge a phone. The advantage of using a solar-powered phone charger is its portability. With this, cellphone can be charged without plugging into a power source.

Photovoltaic converters or solar panels are a type of device which convert sunlight easily and directly to the electric energy. Solar panels directly convert solar radiation into electrical energy. They are mainly made from semiconductor materials. Silicon used as the major component of solar panels, which is maximum 24.5% efficient [2].

Mobile phone charging and operating a LED lamp powered via solar panel is presented in [3]. In this project-based work the author has designed a circuit consisting of 7808 and 7805 ICs to supply a constant 8 V and 5 V DC. The 5 V supply is used for mobile charging and 8 V for charging a 6 V battery. Here, the authors used larger sized solar cells and this is not portable. A microcontroller-based system has been designed to charge mobile phones using solar cells in [4]. AC input, input from solar panel and storage battery are the three main input sources in this project. An LCD display is used to show the information related to battery. To control the buck converter using microcontroller, hardware PWM Module and an external current sense resistor are used. In this paper the authors have given only the circuit concept. There is no

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information about the solar panel size and portability of the complete project. In [5] authors described a mobile charging system using solar panel based on coin and RFID module. Here, the solar panel has been used to charge battery with coin detecting mechanism, microcontroller, RFID, charging circuit and different phone sockets. The coin-based charger is similar to a vending machine for charging cell phones. The user plugs the phone into one of the sockets and insert the coin for charging. Coin detecting mechanism is used to detect the insertion of the coin and send a corresponding signal to to start charging. This system is used for commercial purposes and the size is big. A wearable and portable solar jacket for charging electronic devices such as mobile phone, iPod, mp3 players and laptop is presented in [6]. The solar panel is attached at the back of the jacket using sticky material. The wires and other accessories were placed inside the jacket, the batteries and charging pins were placed inside the pockets of Jacket. This system is portable and useful for cold countries and not suitable for Bangladesh where we have hot weather almost nine months. A solar energy driven wearable autonomous smart cap for pedestrian safety has been proposed in [7]. The system is capable to detect the obstacles in the pathway and alerting the pedestrian user. Solar panels are used here to energize the system. A solar powered charging backpack capable of charging a mobile phone efficiently is presented in [8]. The size of the panel used here is relatively large and need to carry in bag. This is not suitable for the people who work outdoors for their livelihood like rickshaw puller, farmers and day laborer.

In this paper, design and implementation of a solar powered mobile charger system has been presented especially for farmers who used to work in outdoors and usually wear a cap. The small solar panels mounted on the cap upper surface and the tiny electronic circuit provides necessary current and voltage to charge a mobile phone.

2. SOLAR BASED MOBILE CHARGER FOR FARMERS

The design of the charging circuit and the solar cell need to meet the requirements of the mobile phone. The phone that is used here has a Li-ion battery with a capacity of 900 mAh, a nominal voltage of 3.7 V and a charge up voltage of 4.2 V. The phone has a micro USB charger connection. So, the charger cable needs a micro USB connector for phone side and a USB version 2.0 connection for the charger circuit. In the subsequent section different parts of the mobile charger will be presented in detail.

2.1 Solar Panel

There are various types of solar cells available in the market. Since in the present work the cells will be placed on the cap made with bamboo so, need to choose a special one which will be small in size so that it can be mounted on the cap. Here, we have used polycrystalline silicon color solar cells of size 52 mm × 19 mm as shown in Fig. 1. The specification of the cells is given in Table I.

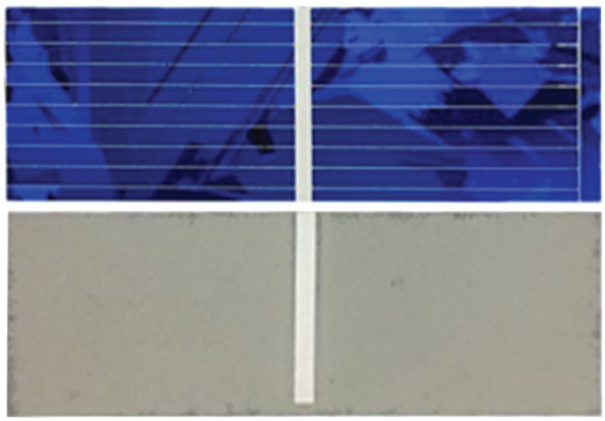


Fig. 1: Polycrystalline silicon color solar cell

Table I: Specification of the used solar cell

Maximum power	0.167 - 0.172 W
Maximum current	0.320 A
Maximum voltage	0.512 V
Short-circuit current	0.34 A
Open circuit voltage	0.564 V
Conversion efficiency	17.4%
Size	52 mm × 19 mm
Thickness	0.25 mm
Solar panels life	5 - 10 years

2.2 Boost Converter

A Boost converter is a DC to DC converter where the output voltage is greater than the input voltage. Since the output voltage of the Boost converter is greater than the input voltage, it is also called a step-up converter. The Boost converter NA076 module is shown in Fig. 2, which works on an input of 0.9 ~ 5V and gives 5V output with around 500 ~ 600mA.

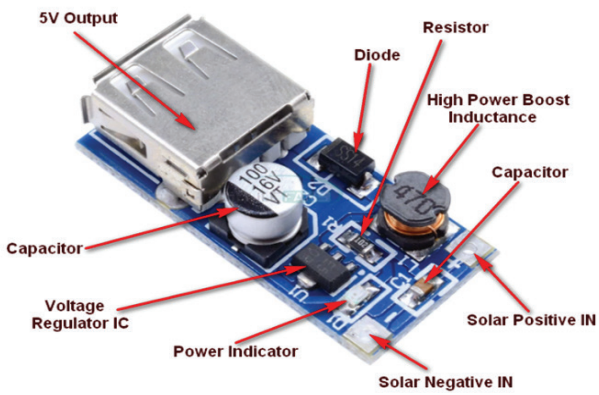


Fig. 2: Boost converter module

2.3 Test Setup for Taking Data

During charging the mobile, the charger setup has been tested for voltage, current and power. The block diagram of the test setup is given in Fig. 3. Here, an Arduino module, current sensor, voltage sensor and Bluetooth module has been used to take data of the system remotely. The sunlight converted into electrical energy is supplied to the Boost converter through a diode. Before connecting the mobile phone via usb, a current sensor and a voltage sensor have been used for current and voltage measurement. The data is taken by the Arduino module and sent to the display device (here, another mobile phone) using the bluetooth module. Figure 4 shows the measurement test setup of the mobile charger.

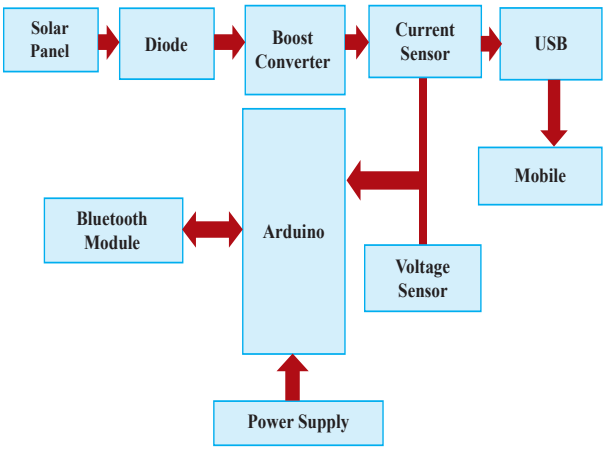


Fig. 3: Block diagram of the mobile charger test setup

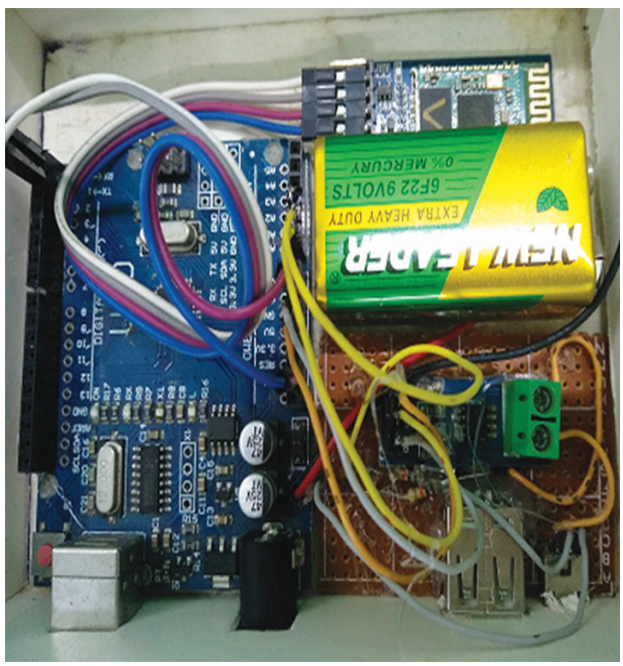


Fig. 4: Physical diagram of the mobile charger measurement test setup

2.4 Final Setup of the Mobile Charger for Farmers

After testing the solar panels in indoor and outdoor we have successfully placed the solar panels on a cap made with bamboo usually used by the farmers of Bangladesh. The complete setup of the mobile charger along with the measurement unit is shown in Fig. 5. Figure 6 shows the real picture how it looks like when a farmer will wear the cap during his stay in the open field.

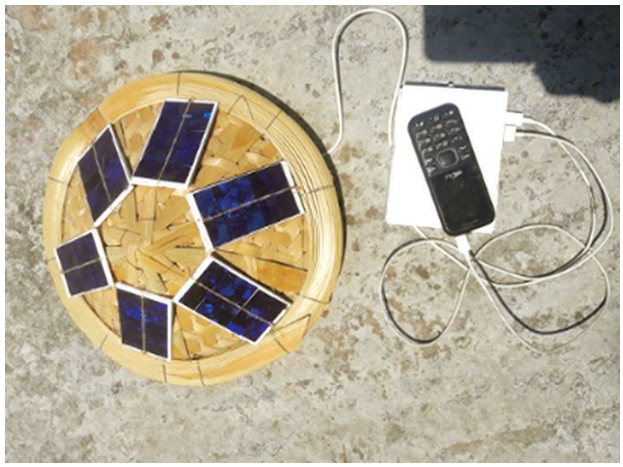
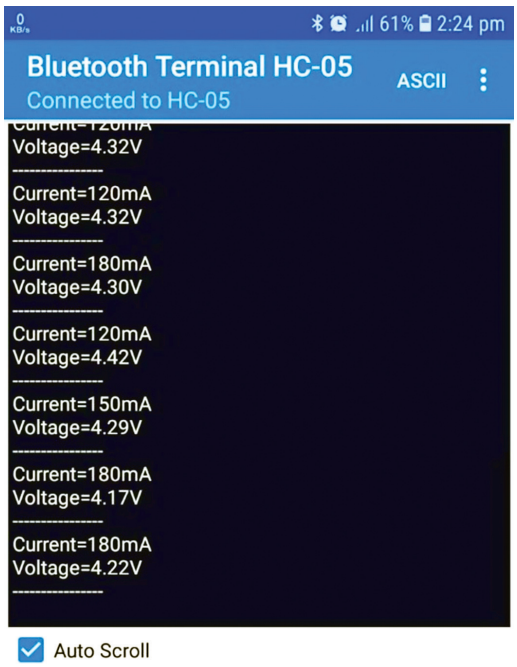


Fig. 5: The complete setup of the mobile charger along with the measurement unit

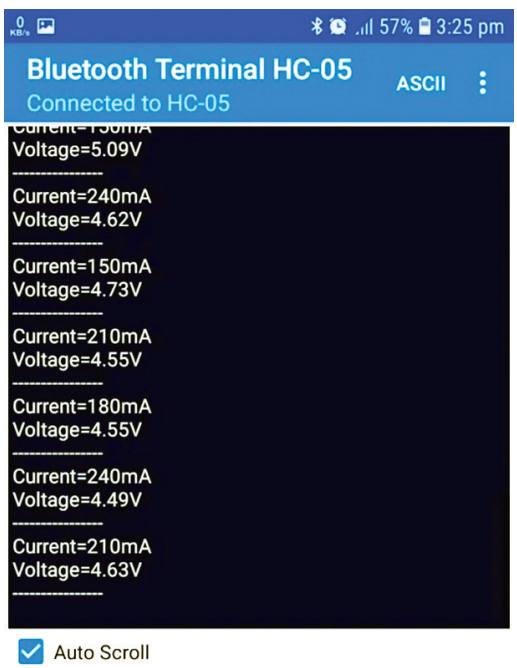
Fig. 6: Solar cap weared by a farmer

3. RESULTS AND DISCUSSION

After completing the setup of solar based mobile charger for farmers we have tested the unit whole day and have taken the measurement of current and voltage during the charging of mobile phone via bluetooth module remotely. Figure 7 shows the data measurement via bluetooth module.



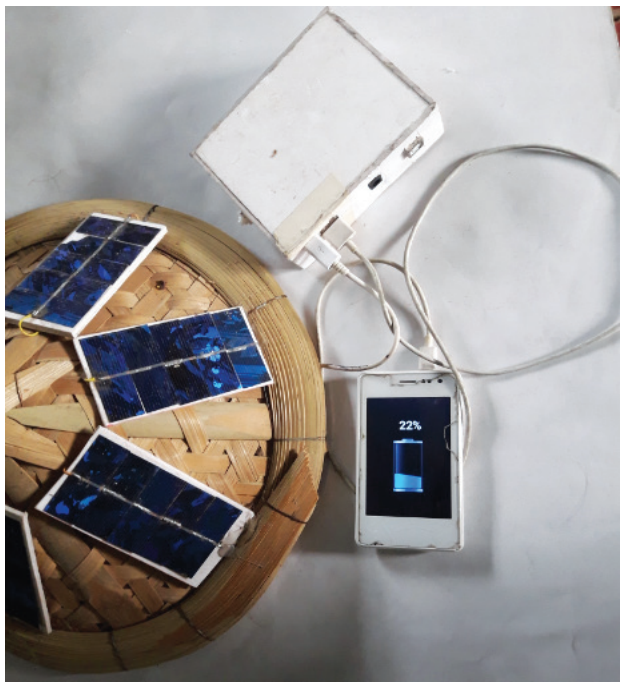
(a)



(b)

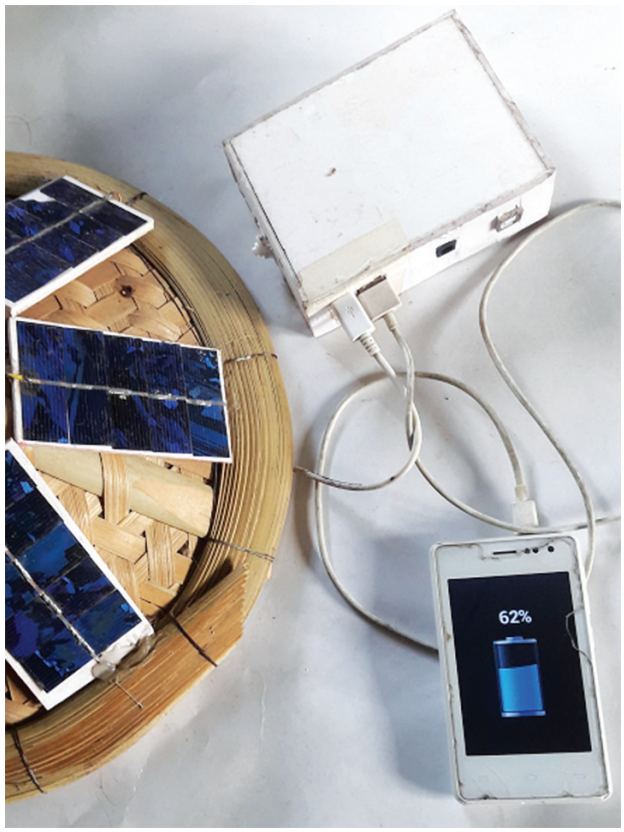
Fig. 7: Measurement data via bluetooth module

We have also tested the charging of a mobile phone having a battery of 900 mAh capacity. Here, the mobile phone was connected to the solar cap via measurement unit. We have charged the mobile phone and at the same time taken the measurement of current and voltage coming from the solar panel. Charging of mobile phone along with the percentage of charged is shown in Fig. 8.



(a)

(b)



(c)

Fig. 8: Charging of mobile phone along with the percentage of charged (a) 22%, (b) 37% and (c) 62%

We have tested the charging of a mobile phone when its charge was 7%. We put the cap in sunlight at about 10:25 am and recorded the charging information up to 67% of charge. The charging information is graphical represented in Fig. 9.

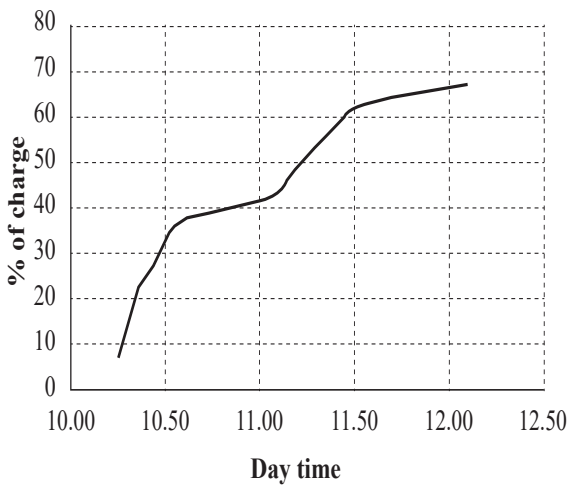


Fig. 9: Charging graph of mobile phone

4. CONCLUSION

The purpose of this research is to design and implement a solar powered mobile charger system especially for farmers who used to work in outdoors and usually wear a cap. The project has been implemented using small solar panels mounted on the cap upper surface and the tiny electronic circuit provided necessary current and voltage to charge a mobile phone. We have selected a small sized Polycrystalline silicon color solar cell having a maximum power capacity of 0.172 W and maximum voltage of 0.512 V. We have connected 5 (five) cells in series to make a panel and this type of 6 (six) panels are connected in parallel. Since 5 nos. of series connected cells can give a maximum voltage of 2.56 V, we have used a Boost converter to boost this voltage to around 4.0 V which is required to charge a mobile phone. The six parallel connected solar panels provide necessary current for fast charging of mobile phone. After mounting the panels on the cap, we have used a Bluetooth based circuit to take the voltage and current data of the charger remotely. Putting the cap in sunlight and using a mobile phone having a battery capacity of 900 mAh we have used the charger to charge it from 7% to 67% in about 105 minutes from 10:25 am to 12:10 pm.

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REFERENCES

[1] J. Wilcox, "Grand challenges in advanced fossil fuel technologies," Frontiers of energy research, Vol. 2, Article 47, November 2014.

[2] M. A. Green, E. Mary, D. Archer, and R. Hill, Clean Electricity from Photovoltaics, Imperial College Press, UK.

[3] M. M. Hossain, "Solar Panel Based Mobile Charger and Small Led Lamp," International Journal of Electrical and Electronics Research, Vol. 3, Issue 1, pp. 42 – 46, 2015.

[4] R. Kamble, S. Yerolkar, D. Shirsath, and B. Kulkarni, "Solar Mobile Charger," International Journal of Innovative Research in Computer Science & Technology (IJIRCST), Vol. 2, Issue 4, pp. 35 – 39, July 2014.

[5] R. R. Khawse1, S. S. Shikare, P. Suryawanshi, and A. A. Trikolikar, "Coin Based Mobile Charger using Solar Panel, RFID," International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), Vol. 4, Issue 3, pp. 990 – 992, March 2015.

[6] U. Syeda and A. Memona, "Design and Manufacturing of Solar Jacket for Charging the Mobile and Laptop Devices," International Journal of Current Engineering and Technology, Vol. 2, No.4, pp. 365 – 368, Dec. 2012.

[7] P. Kalra, D. Mittal, Prince, and E. Sidhu, "Autonomous solar smart cap (ASSC) for pedestrian safety," 2017 International Conference on Big Data Analytics and Computational Intelligence (ICBDAC), pp. 307-311, Chirala, 2017.

[8] J. Taverne, F. M. Sukki, A. S. Ayub, N. Sellami, S. H. Abu-Bakar, N. A. Bani, A. A. Masud, and D. Iyi, "Design of Solar Powered Charging Backpack," International Journal of Power Electronics and Drive System (IJPEDS), Vol. 9, No. 2, pp. 848 – 858, June 2018.