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Abstract

Battery free cell-phone is one of the new technology in our modern life. Scientists, including those of Indian origin, have developed a new battery-less cell-phone for the first time. A cell phone that can never run out of battery could mean the difference between life and death for people in any emergency conditions. This cell phone consumes a few micro-watt power that means it required very less power and runs by harvesting energy from radio signal or light and it operated without battery (power bank). When within range of a base station, it can pick up on modified radio waves that give it enough power to take calls. In latest cellular transmission converting analog signal into digital data that cell-phone can understand. Instead the battery free cell-phone can also transmit signals to the station through a combination of reflecting those radio wave signals back and the electromagnetic pulses generates vibrations from the devices of microphone to encode signal in the reflected signals. And then to receive signals, it converts or decoded radio signals into sound vibrations that are picked up the signals. Transmitting and receiving signals while simultaneously the battery free cell-phone to operate continuously. Skype calls using its battery free cell-phone over a cellular network, via our base-station. Many alternative battery-free technologies that await on surrounding energy sources, such as temperature sensor or accelerometer, consume power with repeatedly operations. They take a reading and the “sleep” for a minute or two while they harvest enough energy to perform next task. By contrast, a phone cell requires the device or system to operate continuously for as long as the conversation lasts.

Index Terms: Battery free cell-phone, Radio signal, micro-watt power, Microphones.

1. INTRODUCTION

Batteries can be a real drag. They are more costly and must be constantly recharged. Though some battery free sensors can passively transmit few amounts of data, most consumer electronics today still rely on bulky batteries to store power. A group from the University of Washington (UW) has built a battery free cell-phone device that can harness power from radio frequency (RF) waves transmit to it from a nearby base station. In battery free cell-phone shelf components can use harvested power to place a call from a distance 31 feet away from a nearby base station. Receive a call, the entire device consumes just 3.4 approximately microwatts of power. Battery free cell-phone that consumes almost zero power. To achieve the really, low power consumption that you need to run a phone by harvesting energy from the environment. The prototype

cell-phone built with off-the-shelf components, runs on a combination of wireless power and tiny or small amount of solar chargers. It's certainly barebones: the phone can transmit and receive voice signals, drive a pair of head phones,

and not much else. It has neither screen nor memory. Once you connect a call using device, you to push a button to talk. The phone generates its own signal using backscatter, a technique already common in RFID as in radio frequency identification chips that encodes existing radio signals with new information and reflects them back to receiver. An antenna connected to components converts that motion into changes in analog radio signal emitted by a cellular base station. This process essentially encodes speech patterns in reflected radio signals in a way that uses less power. Battery free cell-

phone device is a wireless communication device designed for internet of things devices.

1.1 WORKING

Battery free cell-phone device is the latest technology and it works without battery that means not present power bank in the cell-phone. The cell-phone still uses electricity, it just harvests energy from other sources such as sunlight and radio waves. In battery free cell-phone used photo-diodes to absorb photons from light energy and generate electricity. To squeeze electric juice out of radio waves, the phone just needs an antenna. When radio waves or signals interact with an antenna, the waves produce or create or generate electricity to flow through the antenna. A base station that transmits RF waves or signals to the battery free cell-phone. With both the base station and photodiodes, the phone can operate up to 50 feet or about 15 meters from base station. The cell-phone prototype itself is made of simple materials such as capacitive touch buttons, a circuit board and other off the shelf components, these components are used because they consumes a very less power. Making a simple call. You just punch in the phone number you want to call and the circuit board transmits this data or information through radio waves to the base station in a digital form. The base station takes this data and makes a call on Skype to a cellular transmission. Block diagram of Battery free cell-phone as shown in below.

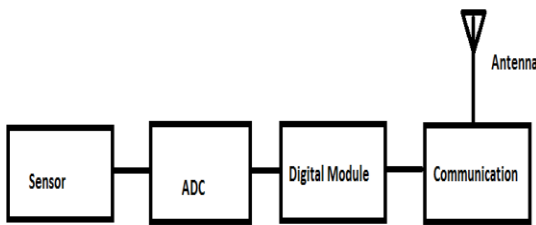


Fig 1. Block Daigram of Battery free cellphone

Fig 1. Shows, firstly we used the antenna for catching the information signal and information signal is in the form of analog signal. And then this signal transmit to the communication block, and this communication block, while communication can be make power efficient using backscatter. The output of the communication block act as a input of Digital Module, in digital module consists micro-controllers and Field Programmable Gate Arrays (FPGA) are the bottleneck in above block diagram of battery free cell-phone. Specially, these module consumes orders of magnitude more power than our target power consumption. And then the output gives to the ADC block, this ADC block

to perform it converts analog signal into digital signal because we need an automatic gain control module to adapt to the variations in the wireless channel. All these functions consumes power, significantly limiting our ability to operate in real time. We observe the performance of a wireless digital microphone system or device using RF signal and photodiode power harvesting. On uplink, the output of sensor is RF signal then we eliminate power consuming conversion process to create a purely analog system that feeds the analog sensor data directly to backscatter module. We observe that a impedance matching network to interface the analog sensor, i.e. electret microphone to the antenna which maximizes the backscattered analog speech signal while simultaneously harvesting power to enable continuously battery free operation. Similarly, on the downlink instead of sending digital data to the device from the base-station, which is transmit or fed to the earphones using a DAC, the base-station transmit analog speech data encoded in the RF transmission that directly to the earphones. We optimize the envelope of the speech encoded RF signal from the base-station. Impedance matching to network simultaneously receive speech and harvest power for RF transmissions and enable continuously battery free operation.

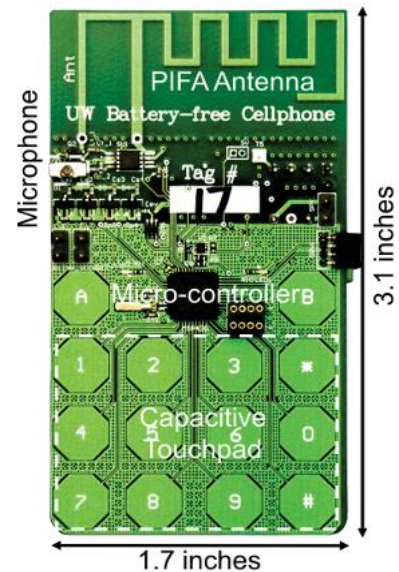


Fig 2. Front view of Battery free cell-phone.

Fig 2. Shows, in battery free cell-phone using commercial off the shelf components (COTS) mounted on a printed circuit board. And we use a printed F antenna in battery free cell-phone shows fig 2. Antenna is the most important for transmission and reception, without antenna no possible transmission the signal and no reception signal in any communication system. Good performance of antenna between size, efficient, non-

directionality operations performed. Our Battery free cell-phone prototype comes complete with capacitive touch buttons and LEDs interact with the user. This system uses RF as well as photodiode harvester to convert RF into light respectively into DC output.

2. OVERVIEW

- A Battery free cell-phone is required to perform three basic operations: sense and transmit speech and receive speech, communicate and co-ordinate with a base-station and the speakers. The Battery free cell-phone system perform all the operations by a directed base-station. At a high level, we delegate all the power consumes by components and operations such as coordinating and communication with cellular network to a base station.
- At physical layer, battery free cell-phone communicate with base station and communication between phone and cellular network. The phone transmit signal in the form of analog signal through microphone and amplitude modulation to receive the signal in form of analog signal from base station. And then this analog signal converted into digital signal i.e. encoded the signal in the presence or absence of an RF carrier. Then the phone has less power required.

2.1 BATTERY FREE SPEECH TRANSMISSION & RECEPTION

Battery free cell-phone totally and fully depends on ADC and DAC block based approaches to sending or transmitting and receiving speech or signal consumes too much power applicable for real time battery free application. In this paper present analog techniques for speech transmission and reception that consumes few micro-watts of power.

2.2 TRANSMISSION SPEECH

In transmission section consists various component are used such as antenna, switch, electret microphone. Firstly, antenna catches the analog signal and then analog signal transmit to the RF switch. The RF switch is used to connect and disconnect the microphone from the antenna to configure the phone in voice or speech transmit and other operation modes respectively.

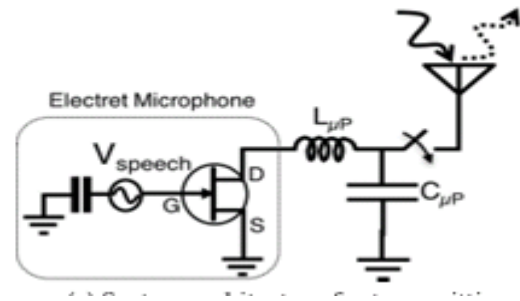


Fig. 3. Transmission speech of battery free cell-phone.

Electret microphone are passive element which does not provided any power. The sensing element in the microphone is a diaphragm, diaphragm is a separate from air gap and fixed metal back plate. When the sound waves move the diaphragm, the distance between two plates of the capacitor change, resulting in a change capacitance. Hence the charge stored in electret is in the fixed manner, and generated small a voltage across microphone.

In transmitter section we used ADC that means the signal converted analog into digital. And this signal control by RF switch, suppose the signal transmit to the microphone that means switch is closed position and suppose the signal not transmitted to the microphone so switch is in open position from antenna. And the output across microphone is in digital form because used ADC convertor then the RF is used so power required will be less.

2.3 RECEPTION SPEECH

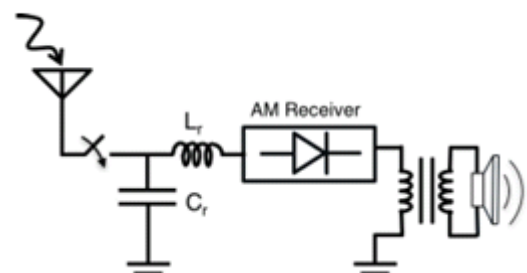


Fig. 4 Reception speech of battery free cell phone.

In reception section are used also various electronics components like antenna, RF switch, AM Receiver and speakers as shown in fig 4. Initially the antenna catches signal from transmitter section and signal in from of digital signal. And conventional digital approaches for receiving speech are also expensive power to be used in battery free devices. A digital downlink communication link, followed by ADC and earphone driver add significant computational and power overhead making it impossible for battery free device to operate

continuously. On the phone, as before, we use an RF switch to connect or disconnect the AM receiver from the antenna. The AM receiver filters out the carrier and tracks the envelope of the carrier to recover transmit speech. An audio transformer is used to interface the AM receiver directly to earphones without need for any driver. The audio transformer is an impedance matching network that ensures that the low impedance of earphones do not load the output of the envelope detector.

As before, by using purely analog approach, we eliminate the need for continuous operation of ADC and digital computation on the cell-phone and delegate these power hungry elements to base station. Instead the phone uses passive zero power element like an envelope detector, to recover the speech or voice signal and actuate the earphones by using the energy of incoming RF signal. And then we get the proper speech output through speakers at receiver side.

3. CONCLUSION

This paper presents the first battery free cell-phone consumes only a few micro-watts of power which its gets from light or Wi-Fi signals. The battery free cell-phone which can enable two way communication with cellular networks up to approximately 50 feet from a base-station. You could imagine in the future that all cell towers or Wi-Fi routers could come with our base station technology and if every house has Wi-Fi router in it.

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