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GENERATION OF ELECTRICITY FROM SOUND ENERGY

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Abstract-**Over the past two decades, there has been significant interest in converting mechanical energy from human motion into electrical energy. This electrical energy can then be used to Recharge batteries in electronic devices or directly power small scale, Low-power circuits. The concept of this project deals with the conversion of sound signal into electrical energy. We have used the Piezo-electric transducer which senses the sound signal and convert it into it's equivalent electrical energy. The output of Piezo plate is given to the ADC for analog to digital conversion and then to microcontroller in order to monitor the value of energy generated. The outputs of transducers are also given to boost controller. The obtained energy is boosted up using Boost Controller and given to DC-DC converter. The output of the DC-DC converter is stored in a storage device. The stored energy is inverted to AC voltage and is given to the relay and utilized for other purposes for lighting lamps for example.**

1. INTRODUCTION

Energy harvesting also known as power harvesting or energy scavenging is the process by which energy is derived from external sources e.g. solar power, thermal energy, wind energy, salinity gradients, and kinetic energy, captured, and stored for small, wireless autonomous devices, like those used in wearable electronics and wireless sensor networks. Energy harvesters provide a very small amount of power for low-energy electronics. While the input fuel to some large-scale generation costs money (oil, coal, etc.), the energy source for energy harvesters is present as ambient background and is free. For example, temperature gradients exist from the operation of a combustion engine and in urban areas, there is a large amount of electromagnetic energy in the environment because of radio and television broadcasting.

Over the past two decades, there has been significant interest in converting mechanical energy from human motion into electrical energy. This electrical energy can then be used to Recharge batteries in electronic devices or directly power small scale, Low-power circuits. In this project we deals with the conversion of sound signal into electrical energy. We have used the Piezo-electric transducer which senses the sound signal and convert it into it's equivalent electrical energy. The output of Piezo plate is given to the ADC for analog to digital conversion and then to microcontroller in order to monitor the value of energy generated. The outputs of transducers are also given to boost controller. The obtained energy is boosted up using Boost Controller and given to DC-DC converter. The output of the DC-DC converter is stored in a storage device. The stored energy is inverted to AC voltage and is given to the relay and utilized for other purposes for lighting lamps for example. Christo Ananth et al.[4] discussed about principles of Electronic Devices which forms the basis of the project.

2. SYSTEM OVERVIEW

Energy harvesting sources including solar, wind and thermal each with a different optimal size. They either waste much available energy due to impedance mismatch, or they require active digital control that incurs overhead, or they work with only one specific type of source. No more research on the vibration domain.

3. PROPOSED SYSTEM

In this project, we are going to propose a new sensitivity-improving method for piezoelectric sensor through external sound. The voltage from the PIEZO plate is given to DC-DC booster which boost up the voltage. The voltage

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is changed to AC which in turn is used to run the home appliances.

BLOCK DIAGRAM

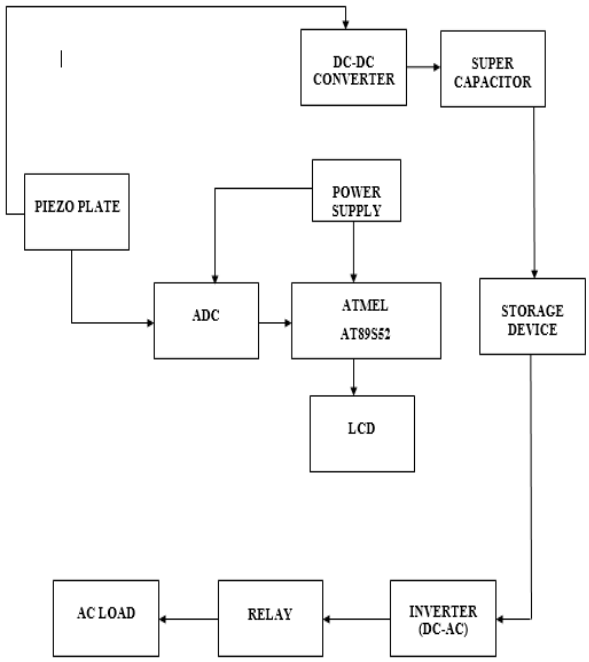

Fig 2.1. General block diagram

CIRCUIT DIAGRAM

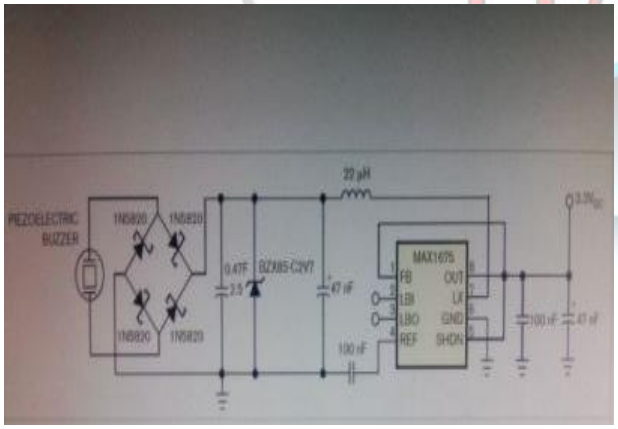

Fig 2.2. Circuit for power generation from sound

4. PIEZOELECTRIC SENSOR

A piezoelectric sensor is a device that uses the piezoelectric effect **to measure** pressure**,** acceleration**,** strain **or** force **by converting them to an** electrical **charge.**

A) Piezo Electric Material

Piezo electric materials are transducers its crystals could convert mechanical strain to electricity, The crystals are formed naturally e.g. quartz, bone, dna ...whereas artificially ZnO , lithium niobatet Lead Metaniobate the sound energy could be converted into electricity using piezo electric material. Let us see the properties of piezo electric material [16].

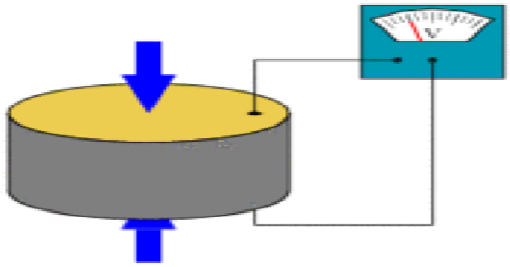

Fig.3.1. Piezo Electric Material

B) Piezo Electric Material And Their Properties

Certain single crystal materials exhibit the following phenomenon: when the crystal is Mechanically strained, (here sound energy) or when the crystal is deformed by the application of an external stress, electric charges appear on the crystal surfaces; and when the direction of the strain Reverses, the polarity of the electric charge is reversed. This is called the direct piezo electric effect, and the crystals that exhibit it are classed as piezoelectric crystal.

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Inversely, when a piezoelectric crystal is placed in an electric field, or when charges are applied by external means to its faces, the crystal exhibits strain, i.e. the dimensions of the crystal Changes. When the direction of the applied electric field is reversed, the direction of the resulting strain is reversed. This is called the inverse piezo electric effect.

So it could be seen that when the sound energy is applied to the piezoelectric material it create strain in the crystal then it reverse it and the strain is converted into electric energy. This direct piezo electric effect property of an piezo electric material could be used for making the device to convert sound energy to electric energy.

C) Piezo converter (srb) -a device could be made using piezo electric material which will collect the sound wave which are travelling near it and that sound wave will be used to cause a strain due to pressure created by its oscillation in the piezo crystal and that will create the disturbance in its atoms resulting in the flow of electric charge on the surface of the crystal thus sound energy could be converted into electricity as the piezo electric material convert mechanical strain to electric energy. And thus this sound energy could be used to perform various tasks by converting it into useful electric energy.

PRINCIPLE OF OPERATION

Depending on how a piezoelectric material is cut, three main modes of operation can be distinguished: transverse, longitudinal, and shear.

TRANSVERSE EFFECT

A force is applied along a neutral axis (y) and the charges are generated along the (x) direction, perpendicular to the line of force. The amount of charge depends on the geometrical dimensions of the respective piezoelectric element. When dimensions a, b, c apply,

$$C_x = d_{xy} F_y b / a,$$

where a is the dimension in line with the neutral axis, b is in line with the charge generating axis and d is the corresponding piezoelectric coefficient.[3]

LONGITUDINAL EFFECT

The amount of charge produced is strictly proportional to the applied force and is independent of size and shape of the piezoelectric element. Using several elements that are mechanically in series and electrically in parallel is the only way to increase the charge output. The resulting charge is

$$C_x = d_{xx} F_x n,$$

where d_{xx} is the piezoelectric coefficient for a charge in x-direction released by forces applied along x-direction (in pC/N). F_x is the applied Force in x-direction [N] and n corresponds to the number of stacked elements . force applied and the element dimension.

5. DC-DC CONVERTER

The MAX1674/MAX1675/MAX1676 compact, high-efficiency, step-up DC-DC converters fit in small µMAX packages. They feature a built-in synchronous rectifier, which improves efficiency and reduces size and cost by eliminating the need for an external Schottky diode. Quiescent supply current is only 16µA.The input voltage ranges from 0.7V to VOUT, where VOUT can be set from 2V to 5.5V. Start-up is guaranteed from 1.1V inputs. The MAX1674/MAX1675/
MAX1676 have a preset, pin-selectable output for 5V or 3.3V. The outputs can also be adjusted to other voltages using two external resistors.All three devices have a 0.3Ω N-channel MOSFET power switch. The MAX1674 has a 1A current limit. The MAX1675 has a 0.5A current limit, which permits the use of a smaller inductor. The MAX1676 comes in a 10pin µMAX package and features an adjustable current limit and circuitry to reduce inductor ringing.

ELECTRICAL CHARACTERISTICS

(VBATT = 2V, FB = OUT (VOUT = 3.3V), RL = ˙∞, **TA = 0°C to +85°C**, unless otherwise noted. Typical values are at TA = +25°C.)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Minimum Input Voltage			0.7		V
Operating Voltage	VIN	1.1		5.5	V

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Start-Up Voltage			0.9	1.1	V
Start-Up Voltage Tempco			-2		mV/°C
Output Voltage	VOUT	3.17	3.30	3.43	V
		4.80	5	5.20	
Output Voltage Range		2		5.5	V
Steady-State Output Current (Note 2)	IOUT	300	420		Ma
		150	220		
		180	285		
		90	130		
Reference Voltage	VREF	1.274	1.30	1.326	V
Reference Voltage Tempco	TEMPCO		0.024		mV/°C
Reference Voltage Load Regulation	VREF_LOAD		3	15	mV
Reference Voltage Line Regulation	VREF_LINE		0.08	2.5	mV/V
FB, LBI Input Threshold		1.274	1.30	1.326	V
Internal NFET, PFET On-Resistance	RDS(ON)		0.3	0.6	Ω
LX Switch Current Limit (NFET)	ILIM	0.80	1	1.20	A
		0.4	0.5	0.65	
LX Leakage Current	ILEAK		0.05	1	µA

Table 4.1. Electrical properties of MAX1675

PIN DETAILS

PIN		NAME	FUNCTION
MAX1674 MAX1675	MAX1675		
1	1	FB	Dual-Mode™ Feedback Input. Connect to GND for +5.0V output. Connect to OUT for +3.3V output. Use a resistor network to set the output voltage from +2.0V to +5.5V.
2	2	LBI	Low-Battery Comparator Input. Internally set to trip at +1.30V.
3	3	LBO	Open-Drain Low-Battery Comparator Output. Connect LBO to OUT through a 100kΩ resistor. Output is low when VLBI is <1.3V. LBO is high impedance during shutdown.
—	4	CLSEL	Current-Limit Select Input. CLSEL = OUT sets the current limit to 1A. CLSEL = GND sets the current limit to 0.5A.
4	5	REF	1.3 V Reference Voltage. Bypass with a 0.1µF capacitor.
5	6	SHDN	Shutdown Input. Drive high (>80% of VOUT) for operating mode. Drive low (<20% of VOUT) for shutdown mode. Connect to OUT for normal operation.
—	7	BATT	Battery Input and Damping Switch

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			Connection. If damping switch is unused, leave BATT unconnected.
6	8	GND	Ground
7	9	LX	N-Channel and P-Channel Power MOSFET Drain
8	10	OUT	Power Output. OUT provides bootstrap power to the IC.

Table 4.2. Pin details of MAX1675

CIRCUIT

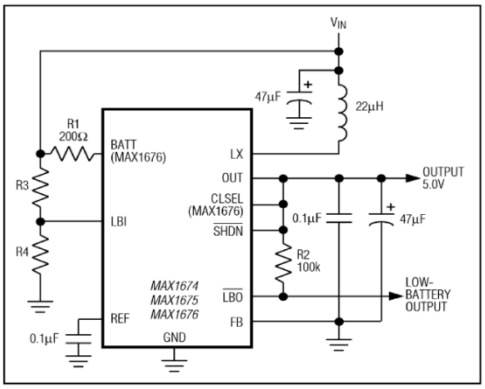

Fig. 4.1. Circuit for DC-DC Converter

6. POWER INVERTER

A power inverter, or inverter, is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source. A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry. Static inverters do not use moving parts in the conversion process.

7. CONCLUSION

Around the world, many industries were working with the high sound enerdy. If we implement our project in those highly noised industrial areas the generation of electricity will become easy and it can be used for usable purpose. Addition to that sound energy is a renewable energy. So that the electricity can be generated continuously.

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