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Self-Power generating Industrial Robot

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Abstract: *Energy has been used at an increasing rate by mankind for its survival and well-being. Due to this exponential growth, the energy is used and wasted in large numbers. The demand of energy is increasing and the methods for producing energy should be eco-friendly and should not cause pollution. Extracting energy from the environment and converting it into usable form energy, this process is known as Energy Harvesting. This project is focused on producing clean and sustainable energy using piezo sensors. The crystalline structure of piezo electric sensors can convert mechanical energy into mechanical energy. They can generate power by absorbing mechanical energy like ambient vibrations, so that it can be used to power other devices. In this project we are using piezoelectric transducers to generate energy by putting weight on the piezoelectric transducers. The generated voltage and current will be amplified and the generated energy will be stored in a battery.*

Keywords: Piezoelectric transducers, IR sensors, Microcontroller, Motor driver, Battery**.**

1. INTRODUCTION

There is currently need to develop robotic devices that rely on new high-performance actuators. Many candidate materials are under investigation to realize actuators. Many of these studies focus on materials that convert electrical energy to mechanical energy. Piezoelectric effect is the effect in which mechanical vibrations, pressure or strain applied to piezoelectric material is converted into electrical form. Piezoelectric effect is the effect of specific materials to generate an electric charge in response to applied mechanical stress.

Electricity can be generated from resources like water, wind, solar etc. to generate the electricity from these resources development of big power plant are required in which high investment and high maintenance cost is included. Some other energy resources are also costly and cause pollution. Key concept of working of this system is capturing unused energy from any surrounding system and converting it into electrical energy. The piezoelectric sensors are placed under insulating material like foam and pressure created by any mechanical stress or heavy weight will generate power and can be used.

2. LITERATURE REVIEW

Service robots are becoming more and more common in everyday life. From vacuum cleaning robots to delivery robots, we have seen their impact in all of our lives. Field robots need to address key problems when they leave the factory floor and go to work in human environments. Industrial automation has recently found more and more acceptance from various industries because of its huge benefits, such as, increased productivity, quality and safety at low costs. Forklifts are used in many places like garbage dump to move garbage tins, in Industries for internal transportations. Many big companies like Google and Facebook use such vehicles for transportation and commuting. The piezoelectric effect is a special material property that exists in many single crystalline materials. Quartz, Rochelle salt, topaz, tourmaline, sugar cane, Berlinite (AlPO4), bone, tendon, silk, enamel, dentin, Barium Titanate (BaTiO3), Lead Titanate (PbTiO3), Potassium Niobate (KNbO3), Lithium Niobate (LiNbO3), Lead Zirconium Titanate (PZT) etc. are examples of such crystalline structure.

The growing uses of these materials are expected to drive the piezoelectric market within the forecast period. The demands from everyday use to more specialized devices, the development of piezoelectric materials has increased. In industries robots are used which are automated and programmable. In automotive industry use these materials in sensors, audible alarms and seat belt buzzers. In addition, in medical industry these materials are used in ultrasonic imaging, disposable patient monitors and fetal heart monitors among others. Xiaomi Inc. launched their flagship concept phone 'Mi Mix' in October 2016 which is one of a kind and known for its very thin bezels and a 91.3% screen to body ratio. For the earpiece they have used piezoelectric sensors so keep up the top thin bezel.

3. BLOCK DIAGRAM

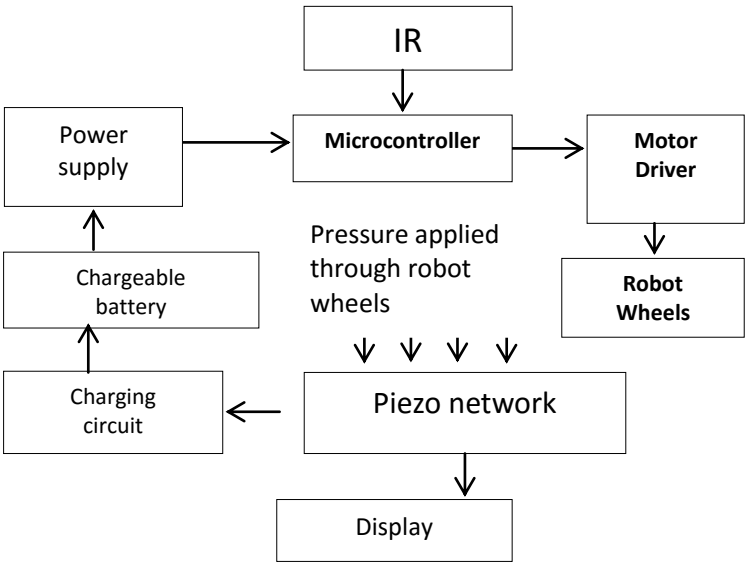


Fig.1. Block diagram

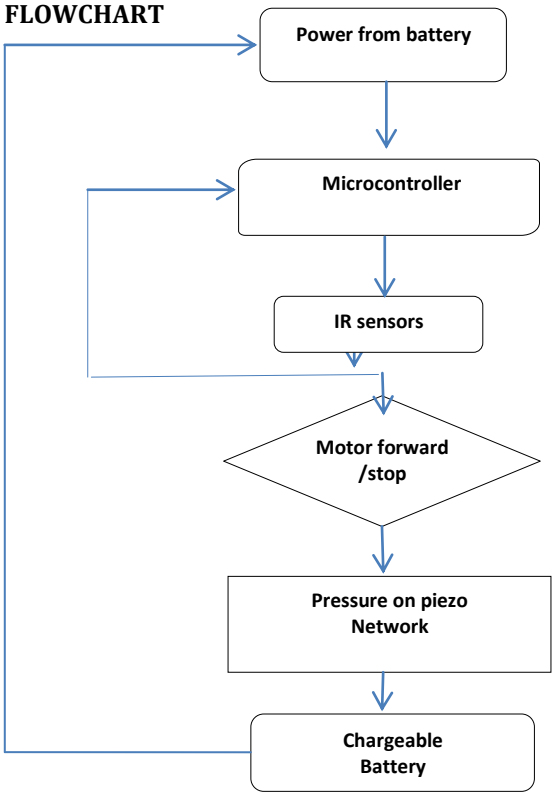
4. WORKING

Piezoelectricity is defined as the ability of some specific materials to produce an electric potential when pressure is applied. Piezoelectric transducers are the main components of the project. As variable forces are applied on the Piezo transducer, different voltage readings corresponding to the force is observed. For every voltage reading across the force sensor, various voltage and current readings of the Piezo test material are noted. As the name indicates "self-power generation", the electricity generated because of the force applied by the weight of the vehicle will be used further to run the microcontroller. The output power generated by the piezoelectric chips is fluctuating. Hence, in order to produce a linear voltage we use a bridge circuit after generation of variable voltage. A rechargeable battery is then used to store this converted dc voltage.

Important concept of working of this system is capturing unused energy from any surrounding system and converting it into electrical energy. The piezoelectric placed under insulating material like hard rubber and pressure created by the product carrying vehicle i.e. line follower robot will produce electrical energy which can be stored and used for transportation purpose.

On proper passing of the vehicle over the Piezo sheet, the generated voltage is used is passed through a charging circuit consisting of amplifiers and voltage regulators that will generate a constant dc voltage. This regulated voltage is then stored in a battery. This power then can be supplied to the power supply circuit which is used to run the microcontroller. The microcontroller acts as the main brain of the project. The microcontroller is responsible for proper operation of the IR sensors. The IR sensors allows robot to follow a marked path and allows humans to indirectly control the robot while it is autonomous. The microcontroller is programmed considering the IR sensors. The value of ADC are adjusted in such a way that whenever the IR sensor detects a white surface, a high value of reactance is sensed and the vehicle moves in forward direction whereas black surface denotes low value of reactance and causes the motor of the vehicle to stop. Detection of such high and low surface reactance the vehicle moves on the marked path without any human attention. Thus, the manufactured load is delivered to the required station.

5. FLOWCHART



6. RESULTS

No. of piezo Used	Pressure applied (kgs)	Voltage (volts)	Current (Amp)
04	2.5	1.7	-
04	10	4.8	-
04	70	19.2	0.1m

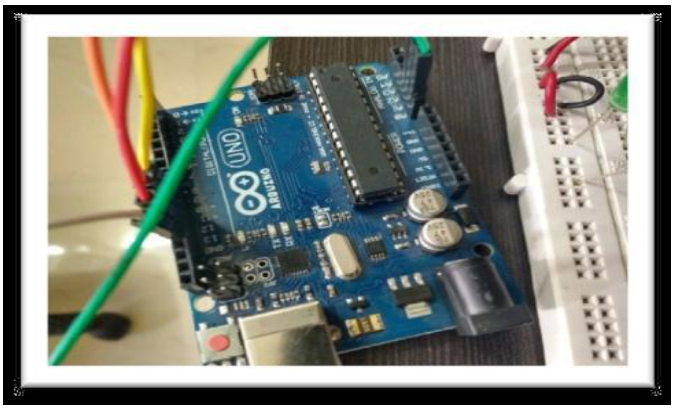


Fig.2

Fig.3

7. FUTURE SCOPES

Piezoelectric transducers can be used to harvest vibration energy from humans walking, vibrating of machines, or movements of cars on roads is a great area of interest, because this vibration energy is otherwise wasted. As movement can be captures anywhere, the ability of capturing such energy in cheap and useful ways, would be an excellent advancement and provide great e-efficiency and clean energy production.

1. Piezoelectric Flooring

The floor system can be engineered with springs and a series of crystal and ceramic blocks. Each person can produce energy between 5-20W. The East Japan Railway Company worked in conjunction with Keio University to imbed Piezo in the floor of terminals and train stations [1]. This technique can also be implemented in health and fitness clubs. Digital Safari Greenbizz Company is aiming to capitalize on the technology by building piezoelectric floors and quotes Time Magazine by indicating 1 watt per breath, 70 watts per step are possible. The product is called "Electroturf".

2. Harvesting Roadways Vibration

The Oregon Department of Transportation (ODOT) evaluated harvesting energy from roadway vibrations [1]. Vendors claimed to be able to capture energy with piezoelectric devices installed under the road layer i.e. 5cm under the road layer. The industry name "Genziko" have been capable of making a product that appears to claim a unit that continues to generate electricity after the wheel impact, indicating a persistently vibrating energy harvesting technology.

3. Piezo transducers installed Artificial Football ground

An artificial football ground in Rio, Brazil has been opened for children's in slum areas. About 200 energy-capturing tiles developed by British startup Pavegen were installed the width and breadth of the field and covered by a layer of AstroTurf. Similar tiles have been employed in airports, shopping centers.

These piezoelectric tiles have the ability to generate as much energy to light up the small stadium. Similar such methods can be implemented in airports and railway stations so that small electronic machines can be powered up.

8. CONCLUSIONS

In this paper we have defined a proper way for harnessing energy through piezoelectric materials. It has been proved that use of energy harvesting system for piezoelectric materials provides a cleaner way of powering vehicles and other equipment. It is a new approach that can lead the world in implementing greener technologies that aim at protecting the environment.

Further experimentation can be carried out for implementing different methods to use power generated from piezoelectric materials. These piezoelectric sheets and tiles can be used in crowded places and at different pressure centers in nearby environments, so as to obtain the advantage clean and sustainable energy.

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