MULTIPURPOSE ROPE TRAVERSING ROBOT

Department of Electrical and Electronics Engineering
MADANAPALLE INSTITUTE OF TECHNOLOGY AND SCIENCE
(UGC - AUTONOMOUS)

Project Work II

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Advanced *Footstep Power Generation By Piezo for Electric vehicles/MOBILES*

- Abstract
- Literature Survey
- Block Diagram
- Hardware Requirements
- Application of piezo electricity
- Conclusion

Abstract:-

Energy consumption represents the development of the universe. Modern world requires a large amount of electrical energy to meet the current demand. But the conventional energy resources are diminishing steadily as a result of vast consumption of energy. So, alternate energy sources are required not to fill up the gap between demand and supply of electricity but also they should be clean, Eco-friendly and sustainable. The main aim of this project is to meet the Energy crisis.

This project is about the generation of electricity through foot steps. The idea is to utilize the force (i.e. weight energy) exerted on the floor when a person walks. The power generating floor intends to translate the mechanical stress applied on the floor to electrical power using piezo sensors.

This technique utilizes peizoelectric components where deformations produced by different means are directly converted into electrical energy via piezoelectric effect.

In this project we are generating electrical power as a non conventional method by simply walking or running on the peizo plates. Non conventional energy system is very essential at this time to our nation.

Literature Survey

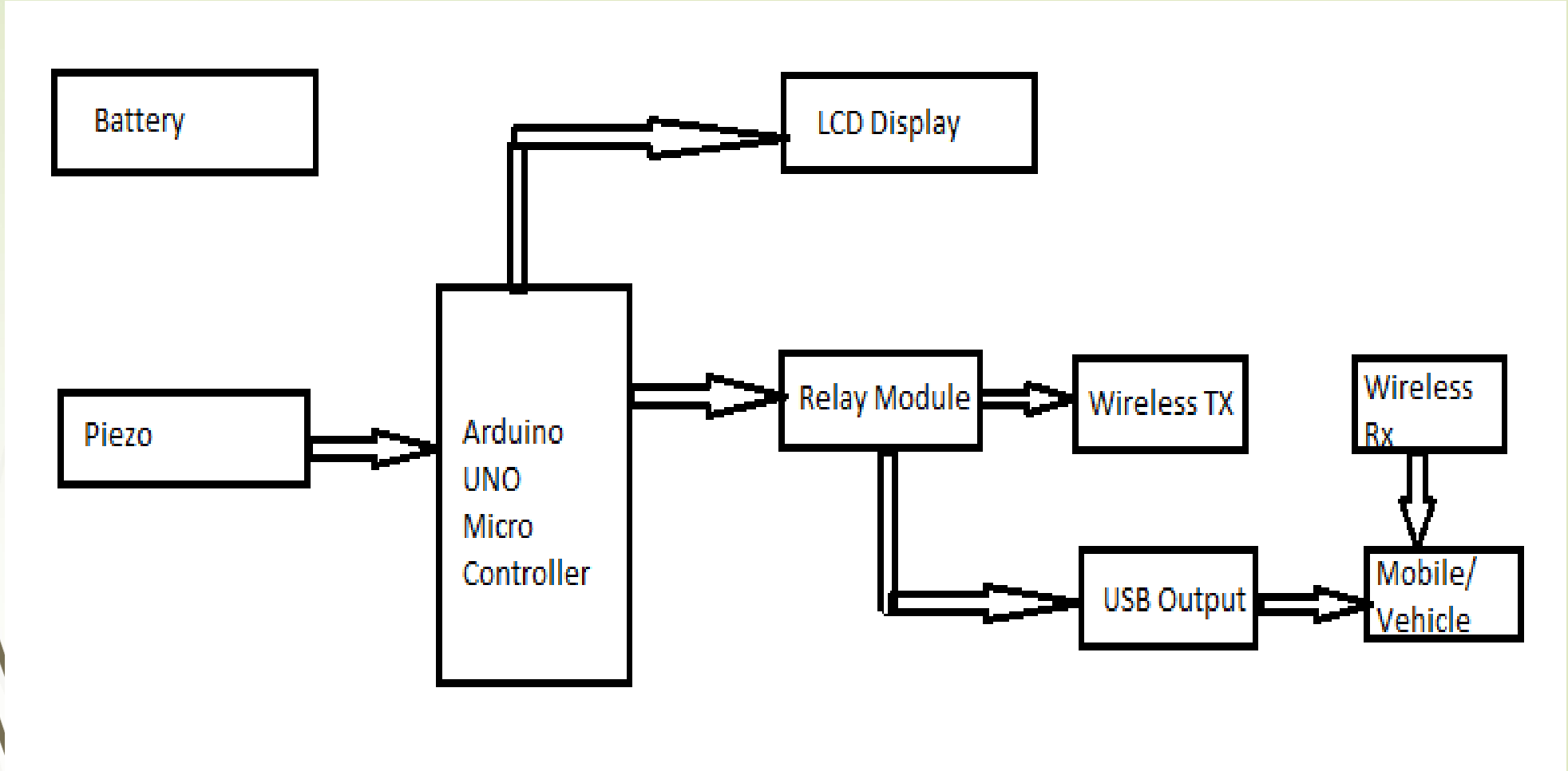
The Literature Survey describes the review of the existing tools and their related work from which the current project is carried out in the further. It also gives the detailed study on the previous work so that it provides the depth of understanding of the existing work. Lots of research has been carried out on the available tools. This gives an idea on this project work to overcome limitations of existing tools.

Introduction

- Piezoelectricity, is discovered by curie brothers in 1880, originated from greek word. “Piezenin” meaning to press.

- The original meaning of the “piezoelectricity” implies “pressure electricity” – the generation of the electric field applied pressure. this definition ignore the fact of the process is reversible, thus allowing the generation mechanical motion by applying a field. Piezo electricity is a observed if a stress applied to a solid, for example, by bending squizzing or twisting it.

Block Diagram



HARDWARE REQUIREMENTS

- Power Supply
- Arduino UNO micro controller
- LCD 16X2 Display
- Piezo
- Relay Module
- Wireless Transmission & Wireless Reception

WHAT IS ARDUINO?

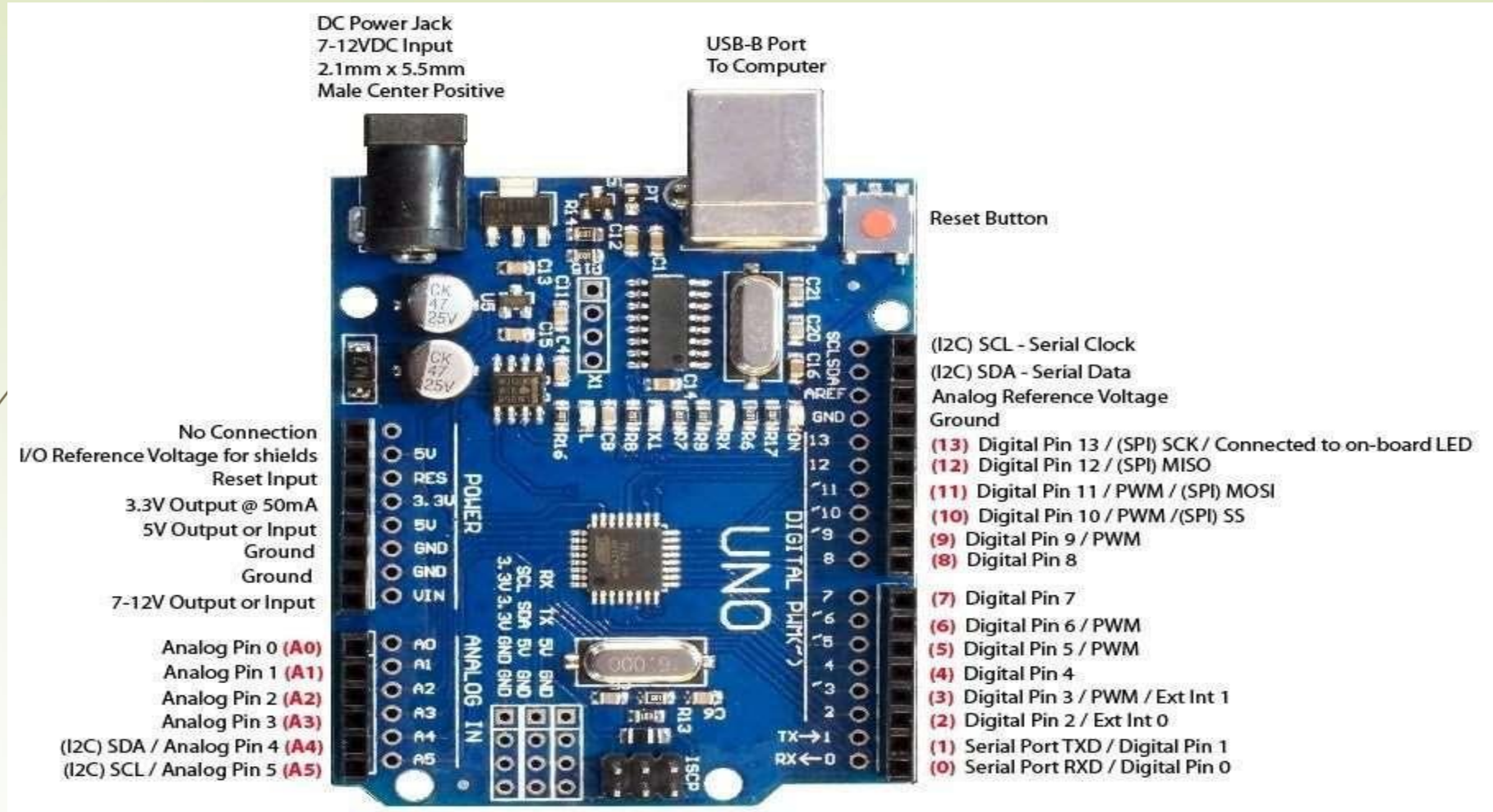
- Development board
- Programmable micro processor (Microcontroller)
- (Digital) Electronics
- Open source
- Read inputs, control outputs!

MICROCONTROLLER

- Arduino UNO Microprocessor Board ("The One")
  - UNO R3 (SMD)
    - 14 digital input/output pins
    - 6 analog inputs
    - 16 MHz clock
    - Small form factor

Arduino UNO

PIN DIAGRAM

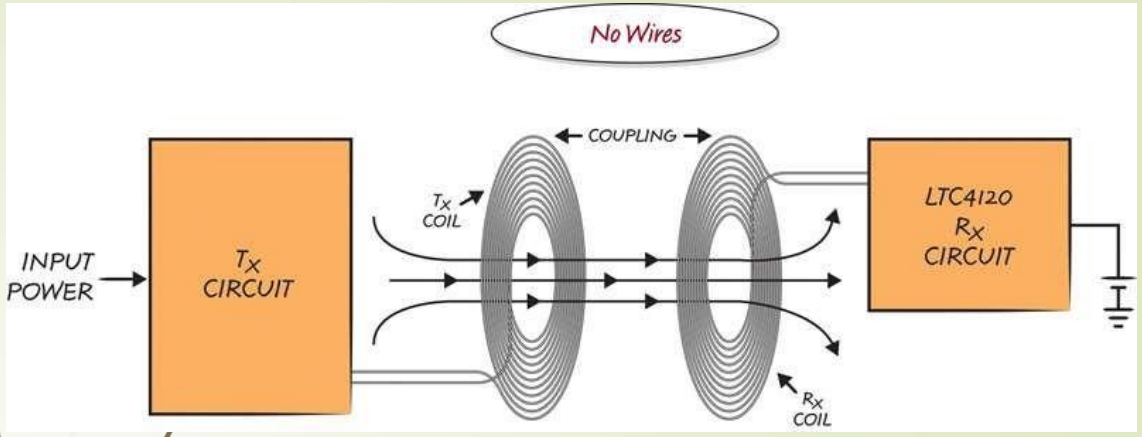


Red numbers in paranthesis are the name to use when referencing that pin.
Analog pins are references as A0 thru A5 even when using as digital I/O

LCD Display 16x2

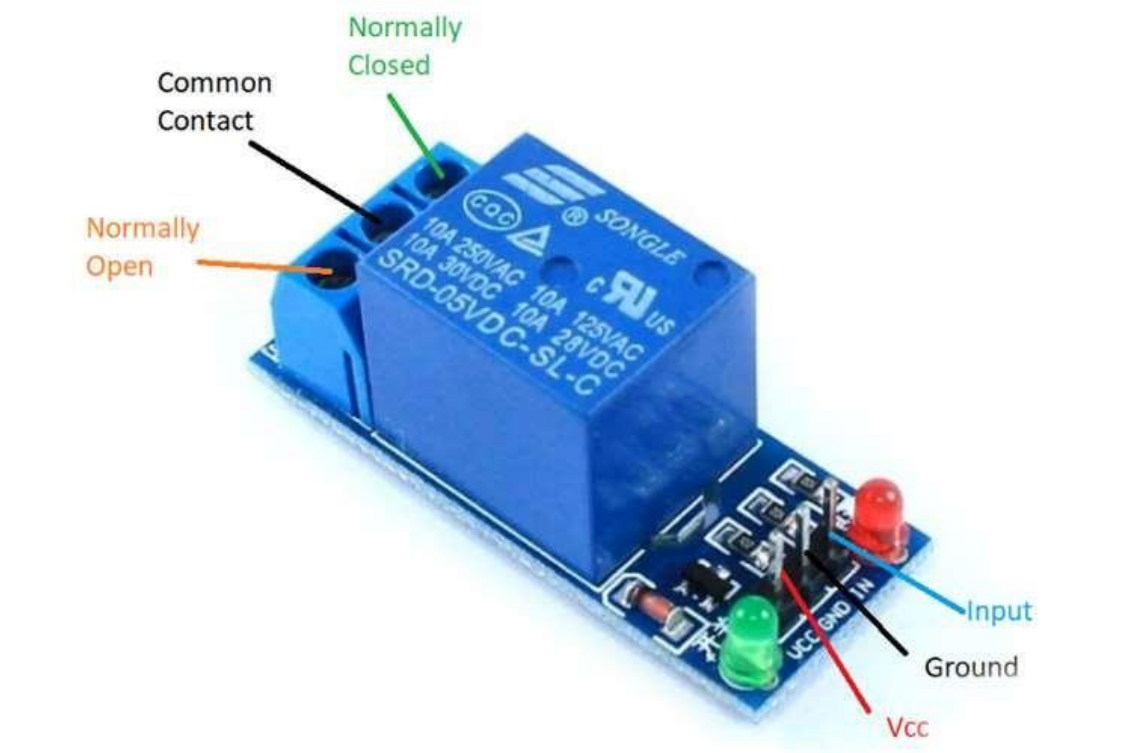
- It is a display device used in Embedded system to display information
- It contains 32 character space on screen arranged in 16 columns and 2 rows

Wireless Transmission & Wireless Reception



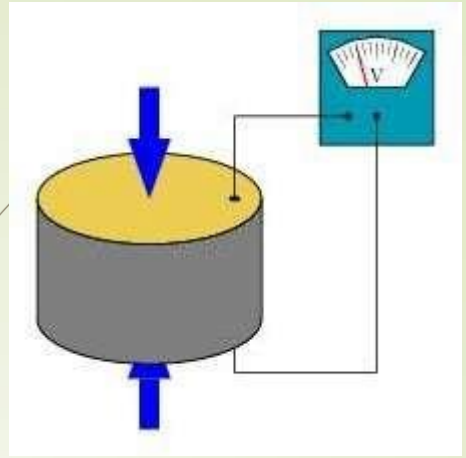
- Wireless transmission and wireless reception are two concepts related to wireless communication. Wireless transmission refers to the process of transmitting data or information wirelessly over a communication channel, such as radio waves or infrared signals, without the use of physical cables or wires. This transmission can occur between two devices, such as a wireless router and a smartphone, or between a device and a network, such as a Wi-Fi network.

Relay Module



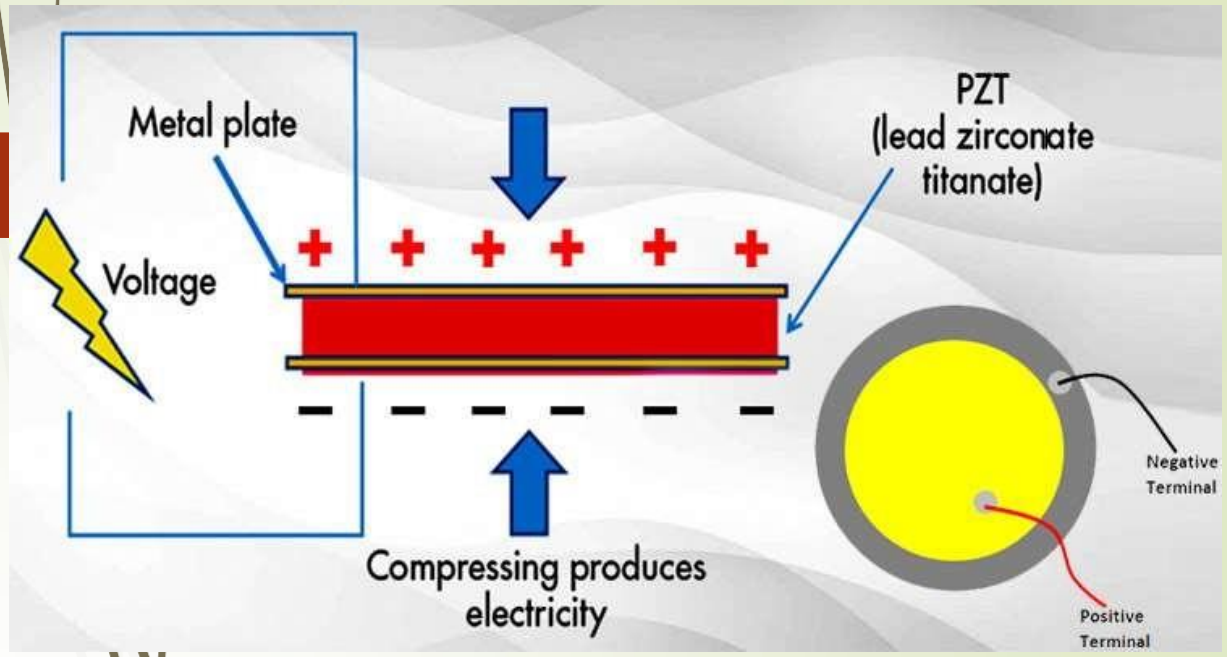
- A relay module is an electronic device that allows you to control high-voltage electrical circuits using low-voltage signals. It consists of one or more electromechanical relays mounted on a printed circuit board along with support components such as power supply, protection circuitry, and connectors.
- There are different types of relay modules available, including single-channel, multi-channel, solid-state, and optocoupler-based modules. Single-channel modules have one relay and are ideal for simple control applications, while multi-channel modules have multiple relays and are suitable for more complex control applications. Solid-state relay modules use semiconductors instead of mechanical contacts to switch the high-voltage circuit, and optocoupler-based relay modules provide isolation between the input and output circuits, making them useful for applications that require high levels of safety and reliability.

Piezo



- A **piezoelectric sensor** is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electric charge.
- The word is derived from the Greek word piezien, which means to squeeze or press.In 1880, Curie brothers found that quartz changed its dimension when subjected to an electric field and generated electric charge when pressure was applied.The conversion of mechanical energy into electrical energy is generally achieved by converters alternator type or commonly known dynamo.

PIEZO ELECTRIC PLATES



Squeeze certain crystals (such as quartz) and you can make electricity flow through them. The reverse is usually true as well: if you pass electricity through the same crystals, they "squeeze themselves" by vibrating back and forth. That's pretty much piezoelectricity in a nutshell but, for the sake of science, let's have a formal definition:

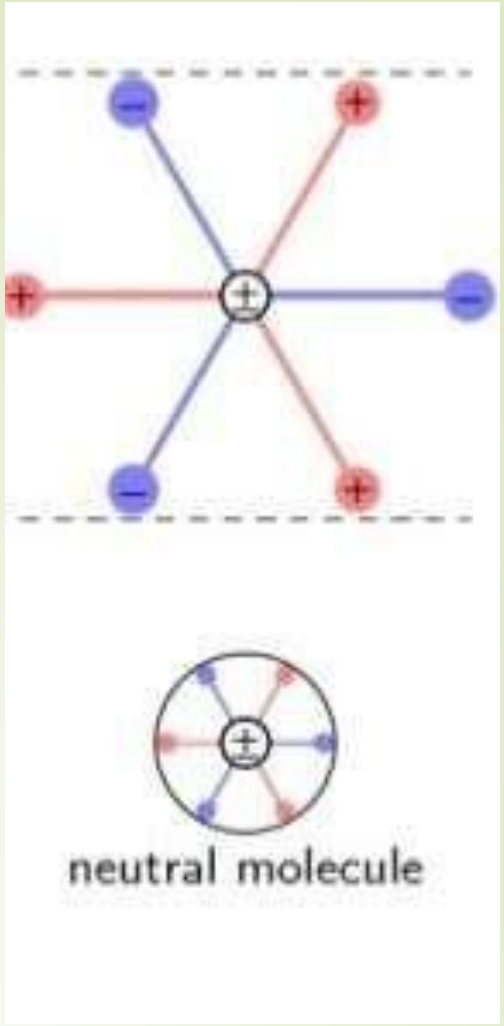
Piezoelectricity (also called the piezoelectric effect) is the appearance of an electrical potential (a voltage, in other words) across the sides of a crystal when you subject it to mechanical stress (by squeezing it).

- The piezo electric effect is special material property that exits many single crystaline material. Such as crystalline structure as quartz, Rochelle salt, topaz, cane sugar, berlinite, bone, tendon, dentin, barium titanate, lead titanate, lithium niobate. Etc.

- **Direct piezo electric effect:-** production of electricity when stress is applied.

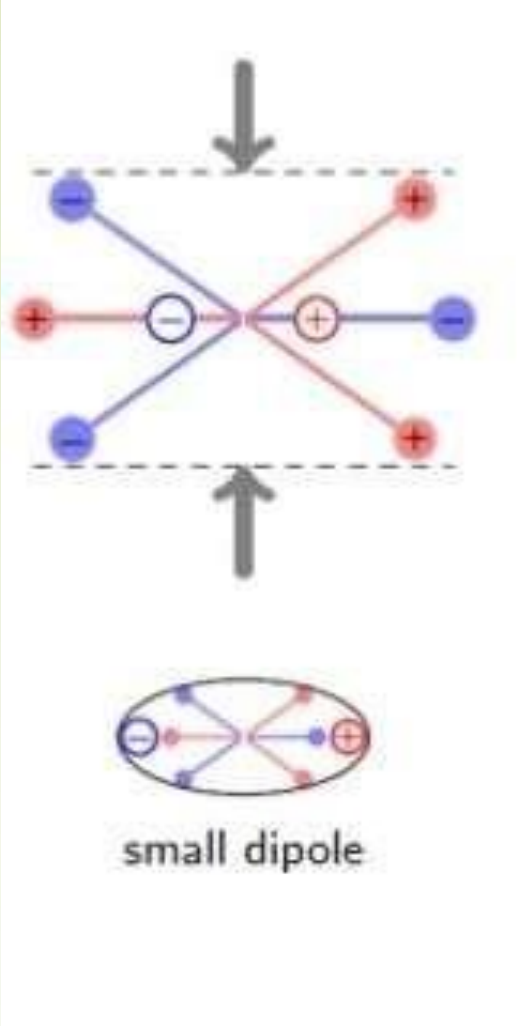
- **Converse piezoelectric effect:-** the production of a stress and strain when electric field is applied.

➢ Simple molecular model:-



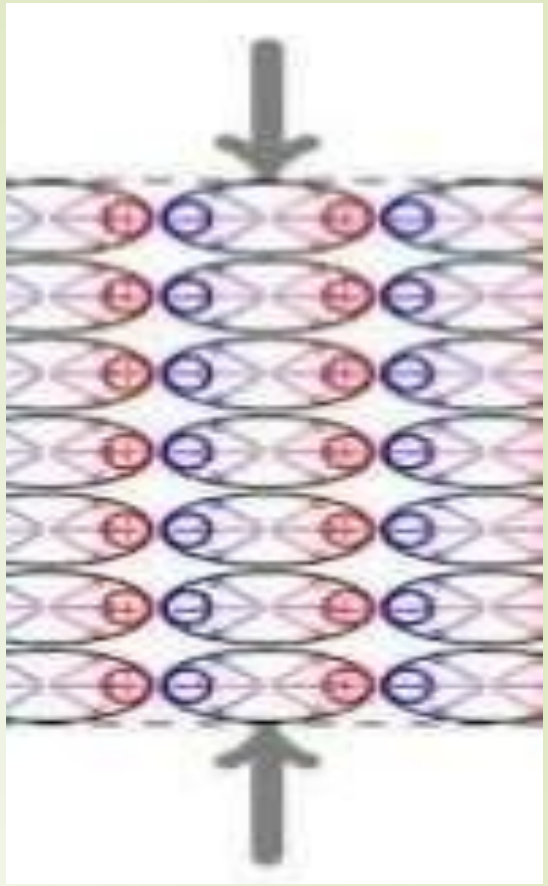
- ➢ Before subjecting the to some external stress :
- ➢ The centre of the negative and positive charge of each molecule conside.
- ➢ The external effect of the charge are reciprocally concered.
- ➢ As a result electricity neutral molecule appears.

➢ Simple molecular model:-



- After exerting some pressure on material :
- The internal structure is deformed.
- That causes of separation of the positive and negative centere of the molecule.
- As the result, little depoles are generated.

Simple molecular model:-



Eventually:-

- The facing of pole inside the material are mutually canceled.
- A distribution of a linked charge appears in a material’s surface and the material is polarized.
- The polarization is generates in a electric field and can be used to transform mechanical energy of material deformation into electrical energy.

Energy harvesting :-

- Energy harvesting describe as changing parasitic energy mechanical energy, for instant of vibration structure, into electrical energy. this energy is used to other purpose for example driving an electrical structure. Circuit of a large capacitor.

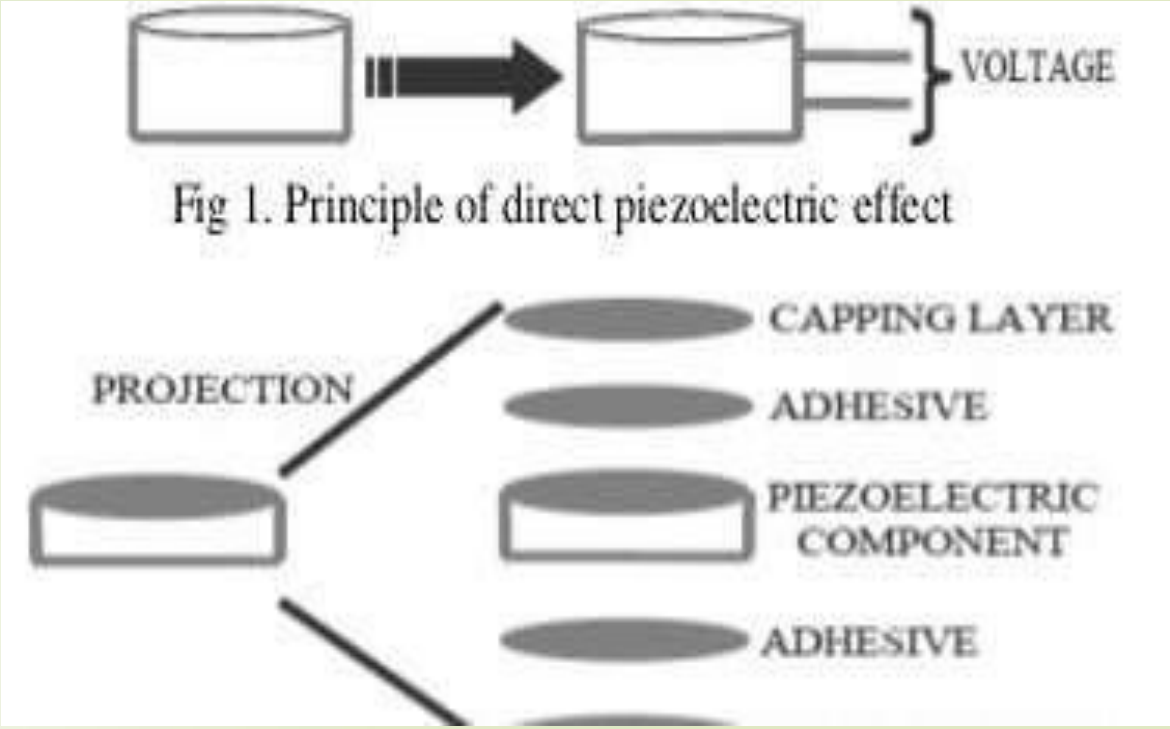
- Energy harvesting is a process by which energy is derived for external source to utilize to drive machine directly .or energy is captured and stored for future use.

Type of Energy Harvesting	Energy Source	Solution	Ultimate Goal
Macro	Renewable sources like solar, wind, tidal etc.	Energy Management solutions	Reduce oil dependency
Micro	Small scale sources like vibration, motion, heat etc.	Ultra-low-power solutions	Driving low energy consuming devices

➢ Piezo electric energy harvesting:-

- Piezoelectric energy harvesting comes under the category of micro scale energy harvesting scheme.

- The energy harvesting via. Piezoelectric use direct piezo electricity effect the phenomenon effect will be clear from diagram shown below.



➢ Source of vibration for crystal:-

➢ **Power generating boots or shoes:-**

- An idea being research **DARPA** in us. In project called energy harvesting, in which include attempt to power battlefield equipment generator embedded in soldier's boot. however this energy harvesting association impact on the body. **DARPA**'s effort to harness 1-2 watt. For continues shoe impact walking were abandoned due to discomfort from additional energy expanded by wearing a shoes.

➢ Sources of vibration for crystal:-

➢ **Gyms and workplaces :-**

Research are also working of idea of utilizing vibration caused from machine in the gym. At workplace while seating on chair, energy can be stored in betteries by also the studies are being carried out utilize the vibration in vehicle. Gears, footstep, footrest.

- **Mobile keypads and keyboard :-**

- the piezoelectric crystal can be laid down under the unit and keyboard. For the press every keys. the vibration can be created piezo electric crystal and hence can be used for charging purpose.

- **Floor mats tiles and carpet:-**

- A series of crystal laid below floor mats tiles. Carpets which frequently use at public place.

SOFTWARE REQUIREMENTS

- ARDUINO IDE 1.8.16
- EMBEDDED C LANGUAGE

PROGRAM :-

```
#include <LiquidCrystal_I2C.h>
#include <Wire.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
#define VpeizoPin A0
float voltage_peizo = 0;
#define RbatteryPin A1
void setup()
{
 Serial.begin(9600);
 lcd.begin(); // initialize the lcd
 lcd.backlight();
 lcd.setCursor(0, 0);
 lcd.print("Foot Step based");
 delay(1000);
 lcd.setCursor(0, 1);
 lcd.print("Power Generation");
 delay(1000);
 pinMode(VpeizoPin, INPUT);
 pinMode(RbatteryPin, OUTPUT);
}
```

```
void loop()
{
 //*************************************************
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.print(" ");
 lcd.setCursor(0, 1);
lcd.print(" ");
 voltage_peizo = analogRead(VpeizoPin);
 Serial.println(voltage_peizo);
 if (voltage_peizo > 5)
 {
 voltage_peizo = voltage_peizo / 50;
 delay(100);
 lcd.setCursor(0, 0);
 lcd.print("Peizo (V):");
 delay(100);
 lcd.setCursor(11, 0);
 lcd.print(voltage_peizo);
 lcd.setCursor(15, 0);
 lcd.print("V");
 delay(100);
 }
```

```
else
{
voltage_peizo = 0;
delay(100);
lcd.setCursor(0, 0);
lcd.print("Peizo (V):");
delay(100);
lcd.setCursor(11, 0);
lcd.print(voltage_peizo);
lcd.setCursor(15, 0);
lcd.print("V");
delay(100);
}
if (voltage_peizo >= 0.1)
{
digitalWrite(RbatteryPin, LOW);
lcd.setCursor(0, 1);
lcd.print("Charging .. !");
delay(10000);
}
else
{
digitalWrite(RbatteryPin, HIGH);
}
```

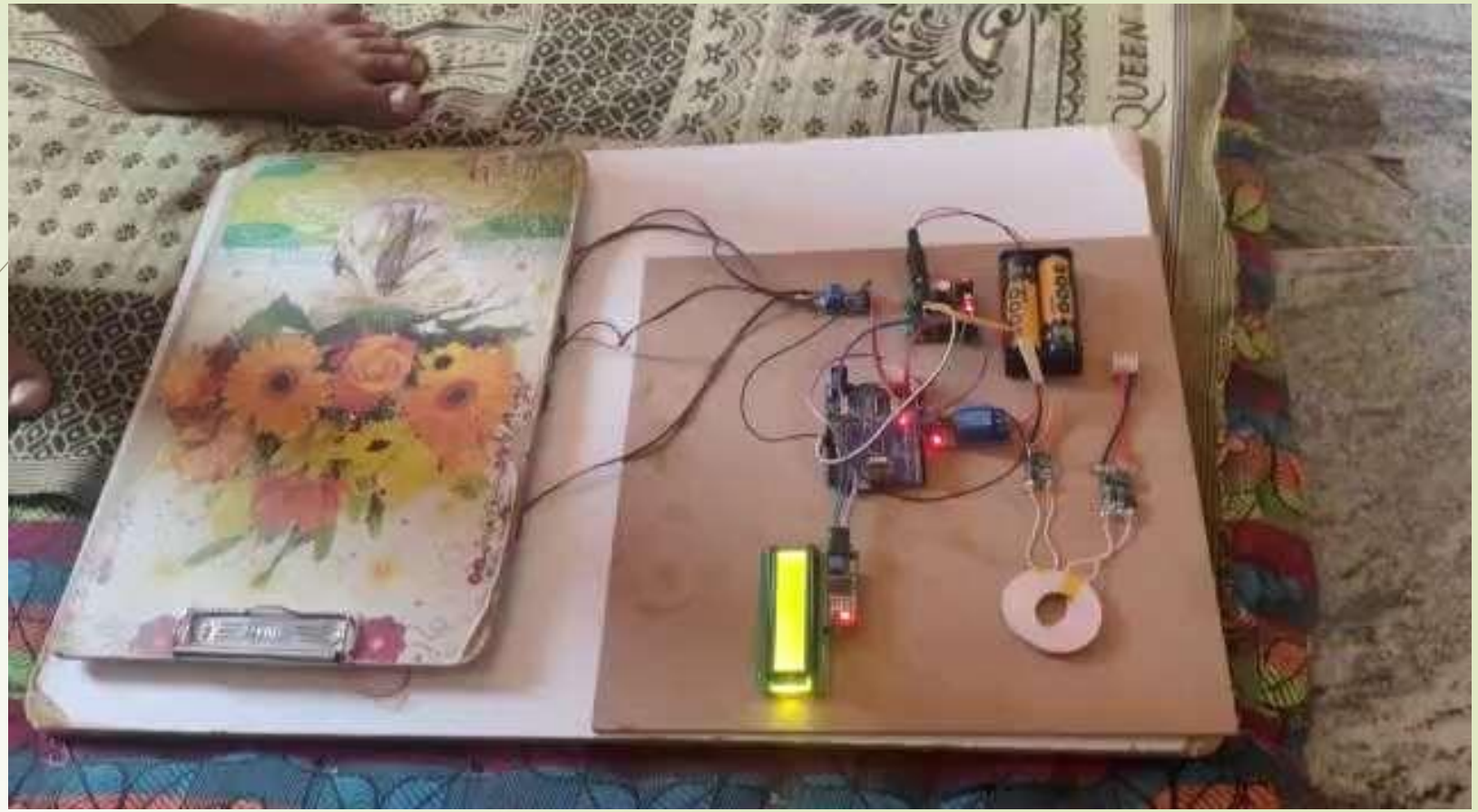
Advantages

- **Renewable energy source**: Footstep power generation utilizes human motion to generate electricity. Since humans will always continue to move, this form of energy generation is a renewable source of energy.
- **Clean energy**: Footstep power generation is a clean form of energy. Unlike fossil fuels, which emit harmful pollutants into the atmosphere, footstep power generation does not produce any harmful emissions.
- **Cost-effective**: Footstep power generation is a cost-effective form of energy generation. The installation and maintenance costs are relatively low, and the energy generated can be used to power low-power devices.
- **Easy installation**: Footstep power generation can be installed in any location where there is foot traffic, such as public spaces, shopping malls, and airports. The technology is easy to install and does not require any major construction.

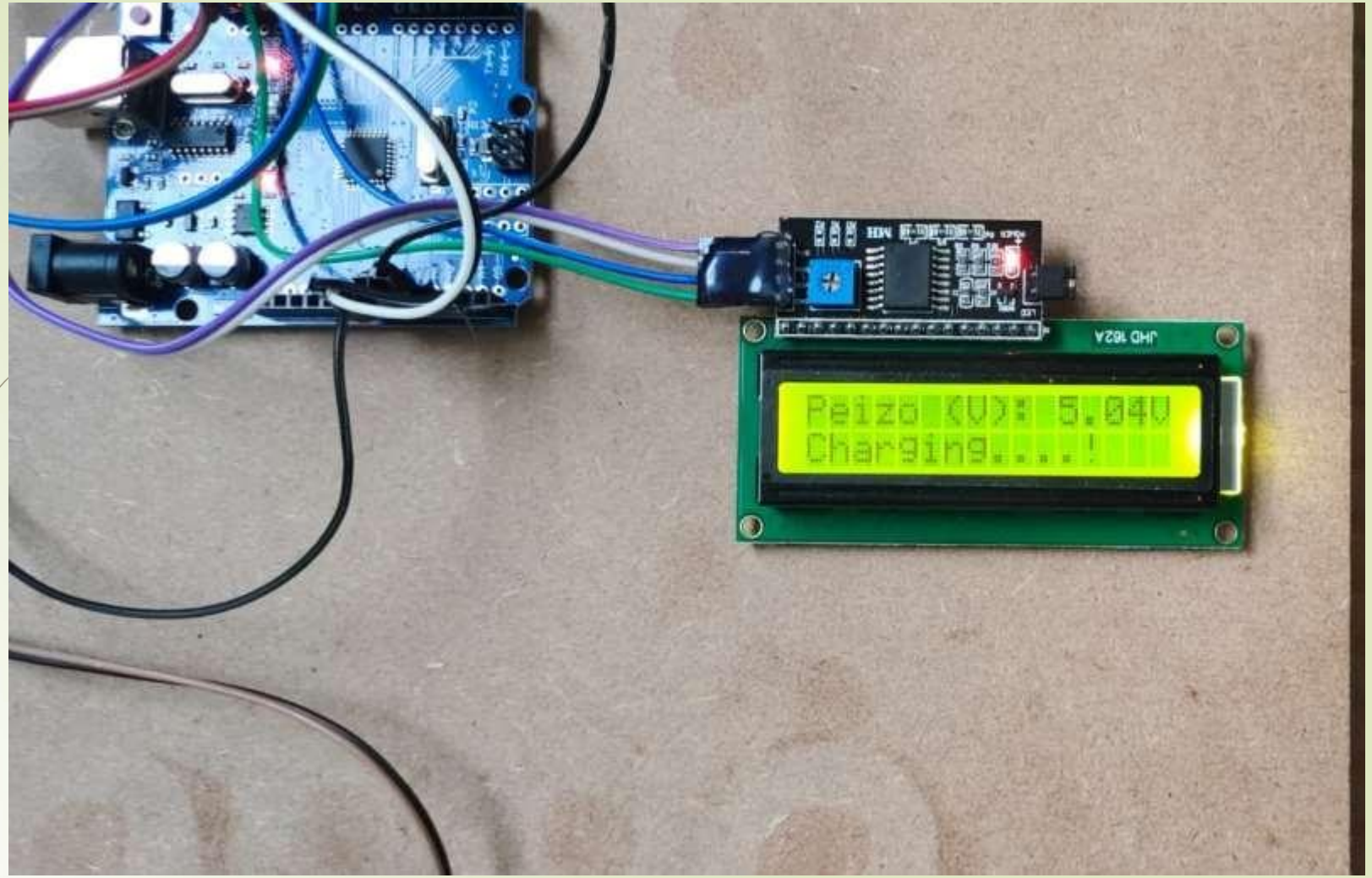
Disadvantages

- **Low power output**: The amount of energy generated by footstep power generation is relatively low. It may not be sufficient to power larger electrical devices or provide significant amounts of power to an electrical grid.
- **High installation costs**: The installation of footstep power generation systems can be expensive, especially if it involves retrofitting existing buildings or infrastructure. This may limit its practicality in some situations.
- **Limited availability**: Footstep power generation can only be used in areas where there is a significant amount of foot traffic. This means that it may not be suitable for rural areas or places where there is low foot traffic.
- **Maintenance requirements**: Footstep power generation systems require regular maintenance to ensure that they are functioning properly. This can add to the cost and effort required to implement the technology.

OUTPUT VIDEO :-



OUTPUT PHOTO :-



Conclusion

- The proposed system is implemented using various module such as Piezoelectric microgeneerator, Boost converter, Battery, Relay unit, LDR and an LCD Display. A low power consuming ARM LPC2148 Controller is used for ADC interfacing and to display the generated voltage on the LCD Display. The voltage generated by the piezo sensors being low, is boosted using a Boost converter to about 15V and stored in the battery to power the 12V DC led bulb. The LDR sensor module detects whether its day or night and the Relay unit performs the work of switching the voltsge stored in the battery to power up the lamp when its night.

Reference

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- Rama Krishna .K "Generation of electric power through footsteps" in International Journal of Multidisciplinary and Current Research Vol.2, ISSN: 2321-3124, Sep-2014

THANK YOU