International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 9 Sep 2023, pp: 332-336 www.ijaem.net ISSN: 2395-5252

Embedded Iot Based Energy Saving Technology in Modern Railway Platforms

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Date of Submission: 15-09-2023 Date of Acceptance: 25-09-2023

ABSTRACT
India's total land area of 3,287,263 km2, the railways own about 40,000 km2, of which 22.7% is used for stations and passenger purposes. Platforms where passengers board trains occupy 58% of the space in railroad stations. This platform has a number of energy-consuming devices and information systems in place to serve the passengers. The improvement of energy efficiency is a key objective for railroad companies. An important goal for railway firms is to increase energy efficiency and energy saving mechanism. The reason for this is that greater energy efficiency reduces financial costs to improve environmental behaviour and as a result is to increases the economic and social benefits in the cost-benefit analysis and this will supports public policy in terms of modal shift from other modes to railway.
The IoT and ESP 32 microcontroller based proposed system will reduce the amount of energy used by the platforms, and the centralized information system will improve the effectiveness of data transmission with the help of Sensors, Piezo electric plates, etc... This system can display information in seconds, which can be useful during unexpected schedule changes and multiple abrupt schedule changes. Additionally, this technique can be used anywhere there are significant crowds of people

Keywords: IoT, Energy Saving Mechanism, Sensors, Piezo Electric plates

I. INTRODUCTION

In the realm of power generation, piezoelectric ceramics have emerged as a fascinating breakthrough. These materials exhibit the remarkable ability to generate electric voltages when subjected to mechanical pressure or vibration, giving rise to what we commonly refer to as Piezoelectric Generators, or PEGs. While it's clear that we have a considerable journey ahead before piezo vibration generators become a predominant power source, their potential impact on the world of self-powered wireless electronic devices is undeniable.

Piezo generators are being explored as a means to revolutionize how we power the efficient electronic devices that have become integral to our daily lives. One promising application is the utilization of piezoelectric sensors on platforms, harnessing the energy generated by the movements of people. This energy can be efficiently stored in batteries and utilized whenever needed, even as an emergency power source.

This innovative system encompasses a range of active and passive electronic components, including piezoelectric crystals, voltage regulators, monitors, rectifiers, I2C LCD displays, IR sensors, LEDs, and microcontrollers with internet connectivity capabilities. Through wireless data transmission, the system can be monitored and controlled remotely, making it adaptable to various scenarios, such as enhancing the historical significance of Indian railway platforms or powering infotainment systems.

The core of this system is the ESP 32 microcontroller, working in tandem with Google Sheets through an HTTP-based IoT protocol. The system's intelligent design minimizes internal data transmission lines by employing the Inter-

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Integrated Circuit (I2C), enabling centralized control of multiple infotainment systems from a single location. This introduction highlights the transformative potential of piezoelectric technology in the realm of energy generation and its applications in modern electronic systems.

II. SYSTEM IMPLEMENTATION

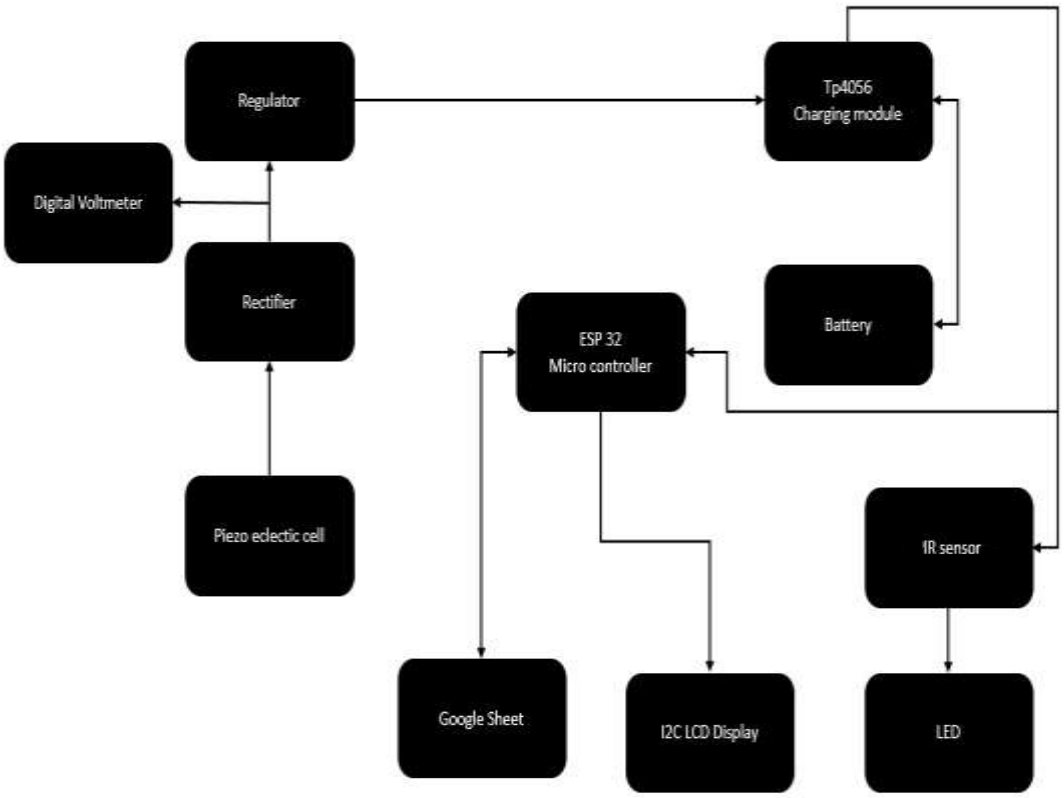

Figure 1: Block Diagram of energy saving mechanism in railway platforms using IoT

Figure 1. The core component of the proposed system is a Piezo crystal or Piezo electric plates which are placed one upon another, separated by insulation material, and made as a cell unit. This cell unit will produce AC, and produced energy is converted to DC, and the voltage is regulated, and the voltmeter will show the produced volts, and the volt is controlled by a regulator IC to make protect from higher voltage than the required, the regulated voltage is given into the tp4056 module and this module will take care powering other modules and systems which is connected in the proposed system.

The charging module charges the battery and distributes the required voltage; this battery holds up to 3,000 mAh.The major element present in this system is the ESP 32 microcontroller which process and controls the information system with the help of the internet using the Google sheet do get do post mechanism, and based on the entered data, the controller will produce the text output in the LCD.

This system also consists of real-time software for human interface; this is done through Google Sheets, the Google Sheet will allow the user to enter the data, and it posts the data whenever the microcontroller requests the data. the

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microcontroller continuously requests the data for relaying the live data. In the proposed system, to reduce the data lines, the I2C Modules were used to interface the LCD and the controller. Using this concept, n number of displays can be incorporated with the system without adding additional controllers.

This system consists of an IR sensor for monitoring the platform crowd. When the sensor detects the train automatically, it turns off all the lights, and when there is no train or people, 60% of the rays will be turned off. This will save energy up to 46%.

ESP 32 MICROCONTROLLER:

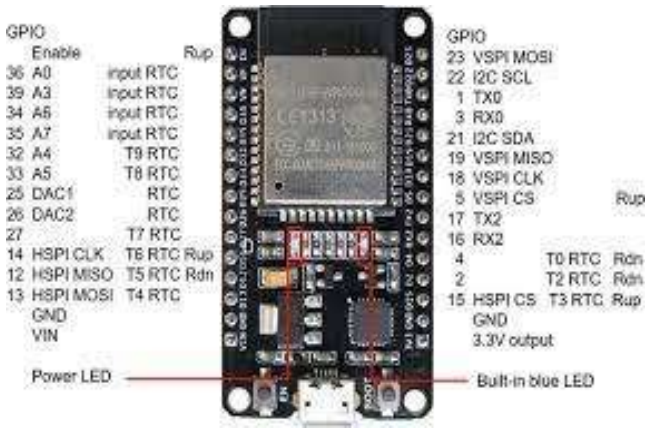

Figure 2: ESP 32 Microcontroller

The ESP32 is way advanced compared to the ESP-12e. Among several features, the ESP32 packs a CPU core, a faster Wi-Fi, more GPIOs (especially increased analog pins that we all desired), supports Bluetooth 4.2 and Bluetooth low energy. The board also comes with touch-sensitive pins, alongside a built-in Hall Effect and temperature sensors.

The specs listed below belong to the ESP32 WROOM 32

- Integrated Crystal - 40 MHz
- Module Interfaces - UART, SPI, I2C, PWM, ADC, DAC, GPIO, pulse counter, capacitive touch sensor
- Integrated SPI flash - 4 MB
- ROM - 448 KB (for booting and core functions)
- SRAM - 520 KB
- Integrated Connectivity Protocols - WiFi, Bluetooth, BLE
- On - chip sensor - Hall sensor
- Operating temperature range - 40 - 85 degrees Celsius
- Operating Voltage - 3.3V
- Operating Current - 80 mA (average)

PIEZO ELECTRIC SENSOR :

Piezo plates are made of thin ceramic sheets. When mechanically stimulated by pressure or vibration, piezoelectric ceramics can produce electric voltages high enough to ignite across an electrode gap. Although piezoelectricity sounds complicated, it is straightforward to comprehend. The Greek word piezo, which literally means to push or squeeze, is whence the word piezoelectric gets its name.

Figure 3: Piezo Electric sensor

The crystals to create an electric current instead of pressing grapes to make wine! Numerous commonplace electrical gadgets, such as speakers, microphones, and quartz timepieces, use piezoelectricity. Simply put, piezoelectricity is the use of crystals to transform mechanical energy into electrical energy or the other way around.

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TP4056A Li-ion Battery Charging/Discharging Module:

Being cautious is usually a good idea while handling lithium batteries. The USB micro cable frequently used to charge smartphones can be used to supply the 5V needed for the module to function. This module can be powered by any kind of mobile charger and its cord. The +5V should be connected to IN + and the IN should be linked to the ground if you intend to power it directly without using a cable.

The pin diagram above should be followed when connecting lithium-ion batteries. Because the module lacks reverse polarity protection, attaching your battery requires extreme caution. Check the polarity of your battery with a multimeter; if it's connected backwards, your module will start to heat up right away.

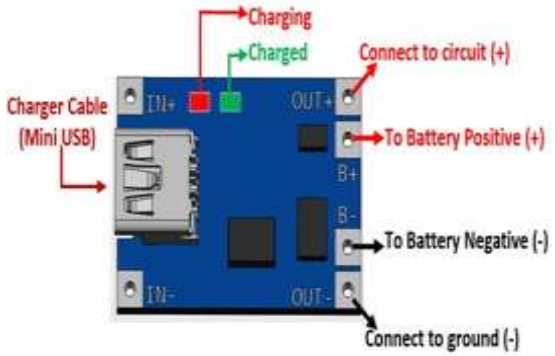

Figure 4 : TP4056A Li-ion Battery Module

IR SENSOR:

Infrared LEDs produce light in this frequency range. Since IR radiation has a wavelength of 700 nm (1 mm), which is significantly longer than visible light, it is invisible to us. Depending on the brand and kind of IR transmitter, IR LEDs have an approximate 20–60 degree light emitting angle and a range of a few centimetres to several feet. The range of some transmitters is measured in km. IR LEDs are transparent or white so they can emit the most light possible.

The photodiode serves as the IR receiver since it conducts when exposed to light. When light strikes a photodiode, which features a P-N junction, it operates in reverse bias, which means it conducts current in the other way.

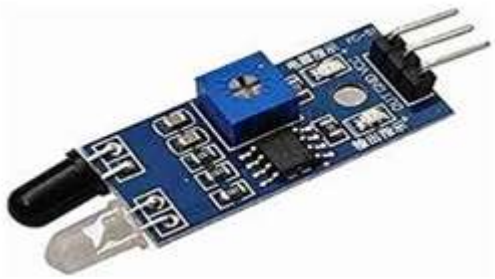

Figure 5: IR sensor

III. CONCLUSION

In conclusion, The "Energy Saving Mechanism In Railway Platform", has been tested and implemented successfully. This mechanism assures that railway platform reaches its maximum level. This system adapts data from the web app and displays it to the passengers at high speed also this system generates power and stores the power as backup in the time of emergency. The smart lighting system helps to reduce the total power consumption by 40%. As a result this system can power productivity is increased and consumption is reduced in railway platforms.

In future this system can also be experimented for road lines and shops where crowd gatherings is more, also in the places where more pressure is given on ground; like heavy vehicle parking areas and also in the sea shores (eel fish mechanism) by placing a chain of plates in the shore and producing energy from the wave shock.

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