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Industrial safety management system using wireless communication technology

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Abstract. The industrial safety management scheme is essential now-a-days due to the drastic growth of industries in the globe. The industrial accidents are majorly caused due to the power problems and power leakages. For ensuring the safety of human lives there is a necessity of new system to provide proper safety to guard the workers from electrical leakages or problems. When an electric current flows through a living organism, it causes a condition known as an electric shock. One milliampere is the smallest current a person can likely detect (mA). Tingling is the mildest symptom; more severe effects include muscular spasms, tissue damage, cardiac fibrillation, consciousness loss and sometimes even death. Electrocution is the term used to describe the result of a fatal electric shock. The complete power unit of a plant or department may be controlled by an embedded assisted shock prevention method, protecting workers from electrical shocks. This system provides the proper safety mechanism to industries and avoids accidental scenarios in proper way as well as the resulting section provides the outcome efficiency of the proposed approach in clear manner.

Keywords: industrial safety management, wireless technology, RF module, risk factors, safety measures.

1. Introduction

An unpleasant static shock can be avoided with the help of a device that discharges static electricity between a person and a grounded object. A high-resistance conductor is sandwiched between a manually engageable first contact and a second contact that makes touch with the grounded item within an insulated housing. The human body can be protected against electrical shock by using electric shock preventers, which consist of a shock sensor element as well as a transceiver module. Components of the current sensing circuit include a power transistor, a sensing transistor configured to reproduce Current flowing through a fixed rate power transistor, a current sensing resistor configured to sense a voltage generated by the regenerated current of the sensing transistor, and an input voltage. An input resistor configured to convert to current, a self-bias cross cascade block configured to compensate for the current across the input resistor, and a current sense resistor. Transmission rates of up to 433MHZ are possible because to the RF Transceiver usage of RF modules in the digital-RF design.

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2. Related work

Incoming mains power is connected through a changeover contact so that the ELCB shuts off power in the event of a ground leakage (unsafe). ELCB detects the short-circuit current from the live (hot) wire inside the protected facility to the ground wire. If a high voltage appears on the ELCB sensor coil, it will turn off and stay off until manually reset, but if it exceeds the rated current, it will only activate, but people will be shocked.

2.1. Drawbacks of existing method

- ELCB operation is disabled by a short load or wire break in the ground path.
- The load must be connected to the ELCB using a third wire.
- Individually grounded units cannot be grounded.
- Detector can be disabled by adding another ground connection to the protection system.
- ELCB detected a hardware fault, but could not determine if someone had accidentally touched a live area of the device

2.2. Proposed method

The proposed method uses wireless technology for detection and prevention of electric shock foremployees working on high voltages in industries. The prototype has low power supply source for microcontroller and other components it is done by stepdown the AC power source using transformer, bridge rectifier and voltage regulator. The Radio Frequency Transmitter in the wrist band detect the voltage spike and sends the 4bit data to the receiver. The RF receiver connected to the main power source when receives the data from the transmitter within the milli seconds it drip the main power source.

2.3. Comparison of the existing and proposed system

In electrical installations with high ground resistance, a protective device called an earth leakage circuit breaker (ELCB) is used to protect against shock. Monitors micro-leakage voltages in metal enclosures of electrical equipment and shuts off circuits when hazardous voltages are detected. Previously popular, more recent installs now employ different systems like our proposed system. The primary distinction is that the suggested system uses RF modules for wireless technology with better sensitivity and response time as opposed to the ELCB, that employs a wired connection.

3. Methodology

A filter, a rectifier, and a voltage regulator make up the power supply circuits. Beginning with an alternating current (AC) voltage, a continuous direct current (DC) voltage may be generated through rectification, filtering to a DC level, and regulation. An integrated circuit (IC) voltage regulator device is frequently used for regulation. It accepts a DC power and produces a slightly lower DC voltage that is constant regardless of the DC input voltage or even the DC load attached to the DC output. The following figure, Fig:1 (a) shows a schematic electrical system and the figure, Fig:1 (b) shows the view of power flow circuit diagram in detail

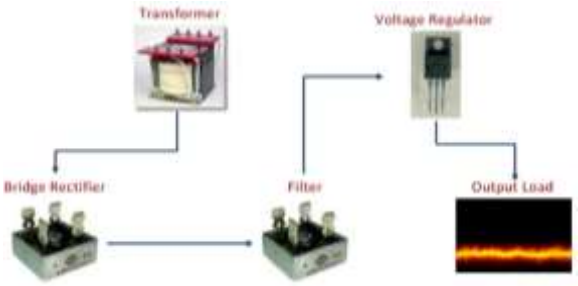

Figure 1. (a) Schematic electrical system.

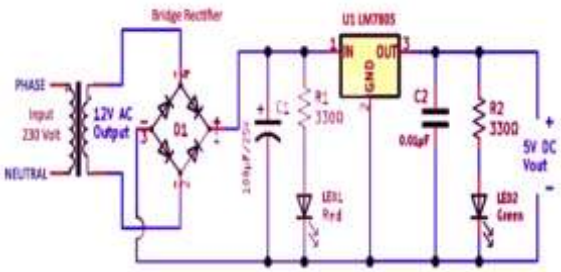

Figure 1. (b) Power flow circuit diagram.

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The present invention relates to a wrist watch RF terminal, which may include a conductive metal housing connected with a band or strap to be chosen to wear on a human body, and formed to be operable as an antenna at a specific bandwidth, a wireless transmission module configured to process a signal transmitted by the housing, as well as a feeding portion configured to electrically connect the metal housing with the wireless communication module. When compared to a scenario in which an antenna is located within a housing with a tiny and restricted size, the metal's function as an antenna transmitting a certain bandwidth has the benefit of facilitating the implementation of wireless performance as well as improving the appearance.

- Ease of Sensitivity Regulation.
- There is less than a 30-ms delay before the switch trips.
- By instantly cutting off electricity, the ESP can avoid electrocution deaths.
- A wide range of sensitivities, from 10 mA to 300 mA, is offered for both single- and three-phase models.

3.1. RF 433 Mhz transmitter and receiver

The wide variety of possible uses for RF modules makes them a popular choice for data transmission and reception in many of our projects. For a radio frequency (RF) transceiver module to function, both its transmitter and its receiver must be present. In order for data to move from one end to the other, it must first pass via a transmitter before it can be received by a receiver.

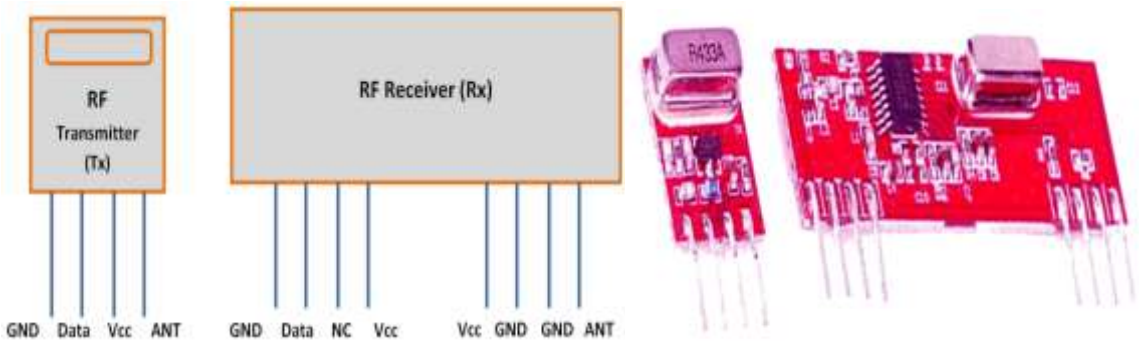

Figure 2. RF transmitter and RF receiver block.

The Transmitter module has the three aforementioned pins (Vcc, Din, and ground). Power may be supplied between 3V and 12V using the Vcc pin. There is a minimum current consumption of 9mA from the transmitter, and a maximum current consumption of 40mA. Thesignal's data will be sent through the middle pin. An RF receiver module requires connection to the power supply (Vcc), the differential output (Dual out), the linear output (Linear out), and the ground. A regulated 5V power source is recommended for use with the Vcc pin. This module draws less than 5.5mA when functioning. To pick up the 433 MHz signal from the atmosphere, you'll need to short the pins dout as well as linear out together. The data is extracted from this signal by demodulation and sent via the data pin.

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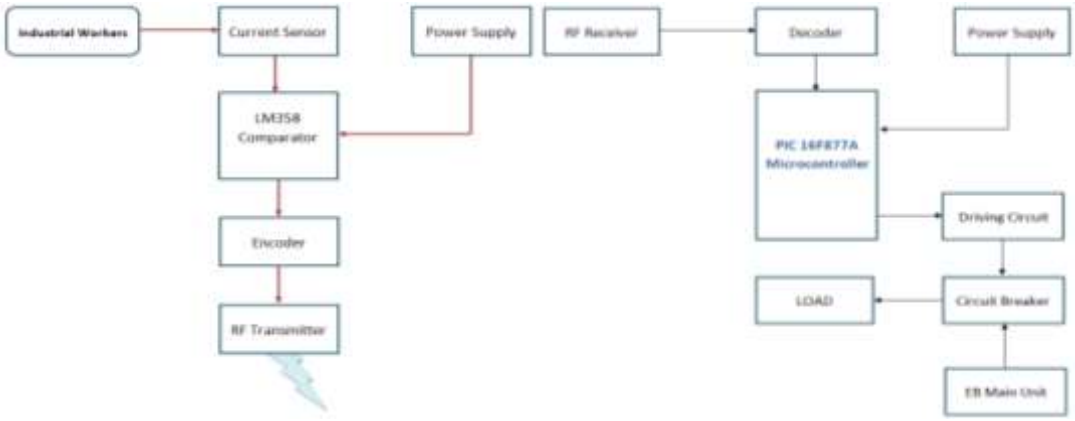

Figure 3. RF transmitter and receiver block diagram.

3.1.1. PIC 16F877A Microcontroller. One of the most well-known microcontrollers available is the PIC16f877a from PIC microcontrollers. This microcontroller is not only simple to code but also simple to utilize. The usage of FLASH memory technology allows for unlimited write-erase cycles, which is one of its primary selling points. It has 40 total pins, with 33 dedicated to input and output. There are a lot of pic microcontroller projects that use PIC16F877A. It's easy to see why PIC16F877A might be useful in a wide variety of digital electronics designs. It has several applications in industrial equipment, home automation systems, security and safety gadgets, and remote sensing devices.

3.1.2. Transformer. The voltage from the power source (0-230V) will be reduced by the potential transformer to a level of (0-6V). After that, an op-amp-based precision rectifier is connected to the secondary of the potential transformer. The DC output from a precision rectifier is at peak voltage, while the RMS output from all other circuits is an advantage

3.1.3. Bridge Rectifier. A bridge rectifier is used to ensure that the input to the circuit always has the correct DC polarity, regardless of the polarity of the incoming telephone line. It is made out of a bridge formed by four individual diodes. The entire AC wave is put to use (both positive and negative sections). Because there are always two conducting diodes in a bridge rectifier, the following figure, Fig:4 shows that 1.4 voltage is used. This is because each diode consumes 0.7V while conducting.

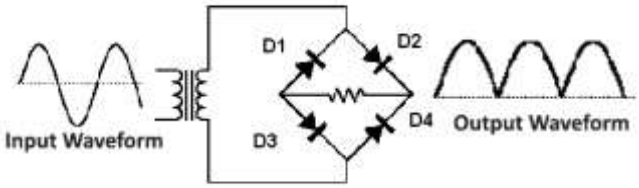

Figure 4. Bridge rectifier.

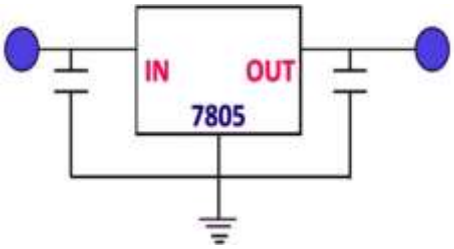

Figure 5. Voltage regulator.

3.1.4. Voltage regulators. One kind of ubiquitous integrated circuits is voltage regulators. Overload protection, a comparator amplifier, a control device, and a reference source are all integrated into a single IC in a regulator IC unit. Although the IC's internal architecture differs somewhat from that detailed for standalone variable voltage circuits, Positive, negative, or programmable voltage control is all available from IC modules. The voltage regulator is shown in a straightforward way in the following figure.

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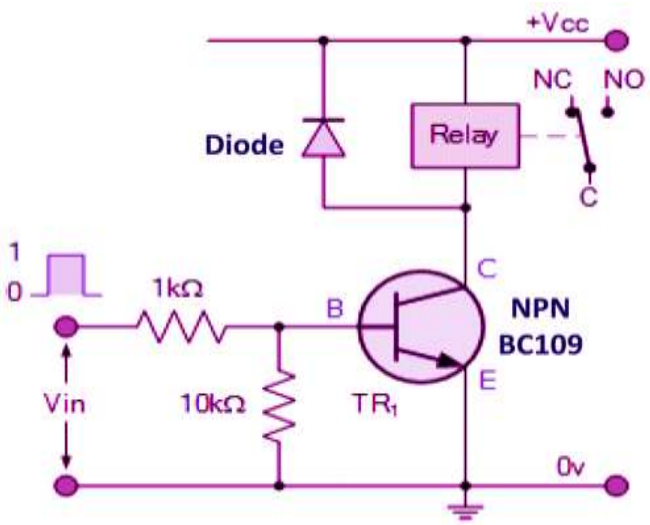

Figure 6. Logical Relay Circuit Diagram.

3.1.5. Relays. Relays are crucial in many circuits, but especially those involving the transmission of large amounts of power or the switching of mains AC loads. In this paper, everyone can understand how to properly use a transistor to control a relay, and then implement that knowledge into an electrical system to reliably switch a load.

4. Results and discussions

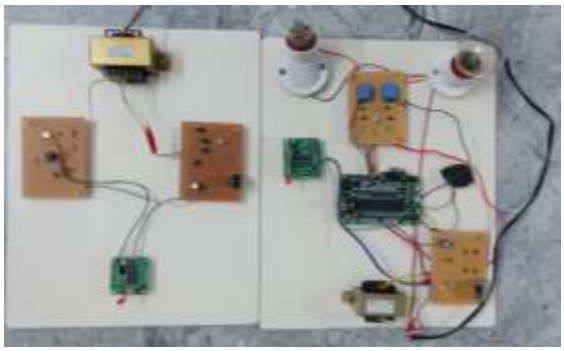

Figure 7. Hardware setup of Industrial safety management system.

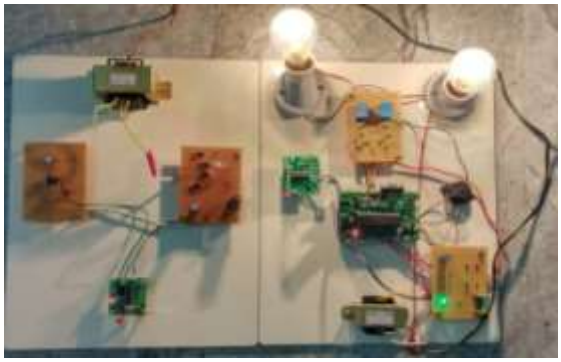

Figure 8. Power supply to Load.

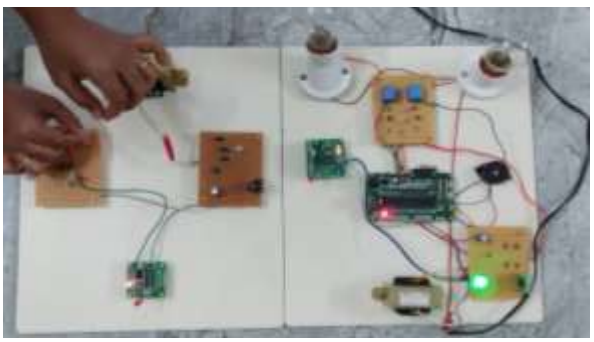

Figure 9. After Dripping the power.

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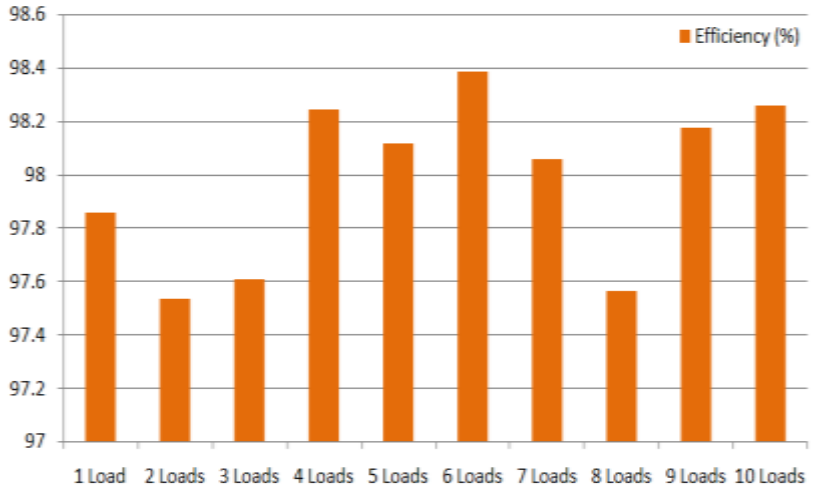

Figure 10. Shock Detection Efficiency.

The Fig:10 illustrates the proposed approach electrical shock detection efficiency, in which the output prototype model is tested with various number of loads and identify the performance of the proposed approach in clear manner.

5. Conclusion

Using this method, identifying and eliminating potential sources of electrical shock is a continuous, crucial endeavour. The tools and methods briefly discussed in this work represent only one attempt. Information about the system's real working environment characteristics may be gleaned from the ongoing field testing of the monitoring equipment. It is evident that work is required to develop a practical method for identifying potential shock hazard situations and one of the simplest and least expensive options available. This invention pertains to electrically powered systems and more specifically to those that, when used as intended, may create a variety of potentially lethal electrical shock danger circumstances. In the future, the invention will be more specifically about a method and system for preventing electric shocks whenever any one or more of its related electrical shock risk situations is present.

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