Smart Gloves For Live-Wire Workers

1R. Senthil Kumar, 2K Prabhakaran, 3Surya Moorthy A, 4Suhail Basha J, 5Dhyaneswaran A and 6Sherothkar S
1, 2, 3, 4, 5, 6 Department of Electrical and Electronics Engineering
1, 2, 3, 4, 5, 6 Vel Tech High Tech Dr. Rangarajan, Dr. Sakunthala Engineering College, India
1rskumar.eee@gmail.com, 2parbaakaran031@gmail.com, 3shivamelectricalengineer@gmail.com, 4suhailplatoon@gmail.com, 5adhyaneshwaran@gmail.com, 6sherothkar@gmail.com

Abstract - Electrocution is an unfortunate mishap prevailing in most of the countries across the world for which the electricians become a dominant prey due to their ignorance in utilizing the safety wearable’s especially gloves. The wearables are usually insulated and tested apart under various testing conditions, thus electrician gloves are designed to withstand 11KV of voltage. These gloves often considered optional by electricians as there’s no mandatory conventions imposed. This lethargic attitude poses the way for fatal electrocution. This paper focuses on building a device which monitors the health of the electrician and which composes of measuring instruments which measures the voltage, ampere, inductance, capacitance, resistance, rotation per minute and connectivity test. The health monitoring system and the measuring instruments are integrated on the insulated electrical gloves. Besides, the gloves do calculate the working hours of the electrician once he wears it. By this, the gloves become mandatory for electricians who work on live-wire.

Keywords - Gloves, Health Monitoring, Measuring instruments, Electrician

1. Introduction
In India, fatality due to electrocution is raised by 30 people per day. Among these, its determined that about 5 people are electrician. The electrocution happens when there’s a lack of safety measures while working in high voltage lines. As per experts, in developing countries like India, there is less awareness on safety and electric equipment is often not used as per standards laid down. Besides, the need of user-friendly measuring instruments has high demand as the electricians working along overhead lines as difficulties as he has to carry a bunch of measuring instruments when poses risk remaining with these instruments at the same time. Moreover, these electricians sometimes work in remote isolated areas, in such cases if their health get affected or if it’s fatal there arises the need of user-friendly device which could report the situation to others or emergency services. They get fainted due to minor accidents and these mishaps are sometimes reported after the electrician reaches his critical health limit. It might be quite challenging to design a system which ensures safety as well as user-friendly. A device which can monitor the health of the electrician as well as measure the electrical quantities is an undeniable need. The gloves besides monitoring the physical health a mental health monitoring system is also necessary. Thus, a wearable which must be designed for the end-users is paramount.

2. Research Background
The existing system advocates the employment of smart glove which monitors mental health. The glove is said to be integrated with temperature sensor, galvanic skin resistance sensor and a pulse sensor which records the temperature, stress and pulse of an individual and then transmits it to the cloud database through Wi-Fi. It also says that the stored data can be again retrieved and processed if needed. The existing system composes multiple hardware and software components linked together which allows smooth data flow in between them. Though the system accomplishes many objectives of mental health monitoring of an individual it lacks the reporting of data in case of any emergency conditions confronted by the individual. The smart glove is not specialized to any profession. Moreover, the blood pressure of an individual is not measured by the system. The existing system thus differs in its aspects of monitoring health as well as it’s not bound to any specialization. The data analytics of health is important. The paper focuses on wearable which monitors the human physical activities which is developed using android operating system and Arduino platform. The system monitors the pulse rate of the individual who wears it processes the information by Arduino lily pad. It employs Bluetooth communication. Thus, the system completely relies on Bluetooth for transmission of data. So, if the Bluetooth is not switched on then the system becomes ineffective for monitoring individual from far places. The paper employs the smart gloves for categorizing accidents and alerting the emergency services. It uses vibration sensor, gyroscope sensor, position sensor, GPS, GSM and biometric sensor for sensing the accident and sending messages. The paper just focuses on alerting the emergency services but it doesn’t provide any preventive measures or promotion of safety gears.

3. Proposed System
The risks confronted by the electricians is succeeded by integrating the health monitoring system and as well as the measuring instruments. The health monitoring system involves IoT platform. In one part of the gloves the health monitoring system is integrated, it consists of Oxy-meter, temperature sensor, stress meter, pulse rate sensor and GPS & GSM module. Thus, if any abnormal changes in health is detected, the GSM sends the message to the electrician’s superior or family which has information about the user’s health conditions such as pulse rate, stress level, temperature and the location [1]. If the health condition is very critical then the message will be sent to the emergency services. In another part of the gloves the electrical parameters such as voltage, current, inductance, capacitance, resistance, RPM of motor can be measured and along with that wireless indication of live wire is done. These parameters are measured with the use of
micro-controller [2]. The proposed system thus facilitates user-friendly gloves which can thus protect electricians as well as support them at various circumstances. The health monitoring system monitors the mental health of the individual too by measuring the stress level of the electrician, therefore the probability of electrocution is minimized effectively. The other part of the gloves can be used for testing electronic components, continuity test, wireless sensing of live wire [3]. The voltage and current can be measured wirelessly. Along with these facilities the timer is switched on once the device is worn. The timer is restarted every 24 hours until then the working hours of an individual is added after every interval (between they removal and re-wear) within the 24 hours. Thus, the working hours of an electrician or user is reported to his superior. By this the device becomes mandatory which thus promotes safety in turn. Thus, the entire system is user-friendly completely [4].

All these parameters are collectively displayed in the Liquid crystal display.

The right glove consists of the following hardware circuits such as voltmeter, Ammeter, resistance meter, continuity tester and wireless testing circuits. The readings are collectively displayed in the seven-segment display.

**Left Gloves**
The following are the components integrated with the left-hand glove.

**Tachometer**
For measuring the rotation per minute of the motors the tachometer part is used. It consists of IR module through which infra-red light is projected and received back for calibrating the rotation. The rotation per minute is processed and displayed in the display by the processor Arduino Uno.

**Capacitance Meter**
For measuring capacitance, the time taken by the capacitor for reaching 63.2% of voltage is calculated and then it is divided by the known resistance value. Thus, it requires additional known resistance value. By this, the value of capacitance can be easily measured. It doesn’t require any additional circuit therefore the cost is also lesser.

**Inductance Meter**
For measuring the inductance LM339 Integrated circuit, diode, non-polar capacitors and resistors are used. By applying a pulse signal to the circuit, which is 5V from the Arduino. Now, the voltage is changed from 5V to 0V. This pulse will create sinusoidal waveform, this frequency is calculated by the Arduino. By calculating the frequency, the inductance of the circuit is calculated. It is determined from the formula and it is made to print in the LCD screen. This doesn’t require additional cost and the circuit is very simple similar to capacitance meter.

**LCD Screen**
The LCD screen is used for displaying the value of blood-oxygen, temperature, pulse and the value of inductance and capacitance. The LCD screen can be replaced with OLED in future enhancement. The LCD can be 16*2 or may be 20*4 which has 5*7 pixels each providing the best output results.

**Sensors and GPS&GSM**
The following are the sensors used in the left glove, it contains DHT11 sensor which measures the temperature, galvanic skin resistance sensor is used to measure the stress of an individual which measures stress by calculating the resistance of the skin, MAX30100 which is an oxy-meter which measures pulse rate and blood-oxygen rate of an individual, GPS module collects the information from the satellite about the latitude and longitudinal coordinates of the user’s location [6]. Thus, by collecting every data from these sensors the health of an individual is monitored effectively. If the individual health is found unstable in any case the GSM will send text message containing the information of location, pulse...
rate, temperature, blood pressure and stress level to the electrician’s superior or else to his family members [7].

**Timer**
The micro-controller besides monitoring the health and measuring electrical parameters, the device begins to count the time once the electrician wears the gloves. The timer gets refreshed after every 24 hours. If the electrician works intermittently for any reasons within the 24 hours then the timer will get paused and it will begin again once he re-wears the gloves [8],[9]. This will make the electrician gloves mandatory to wear. After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar [11-13].

![Fig.3: Left hand glove comprised of health monitoring system and LC meter](image)

**Right Gloves**
The right-hand glove is an integrated circuit consisting of electrical elements resistors, capacitors and transistors which is able to measure voltage, current, and resistance. It can be used for continuity testing and wireless indication of live wire. The voltage range of up to 1000V DC and 750V AC can be measured and current in the range of about 10 A (both AC and DC) can be measured. The maximum resistance that can be measured by the circuit is 2 Mega Ohm. Thus, both the right and left glove form a system which is wearable and electrician-friendly [10].

![Fig.5: Right gloves consisting of integrated circuit which measures voltage, current, resistance and connectivity.](image)

**Table 1: Output of Right Glove**

| Image Output       | Measuring range                                      |
|--------------------|-------------------------------------------------------|
| AC VOLTAGE = 224   | The device can measure the AC voltage of range up to 750V. |
| AC CURRENT = 7.6   | The device can measure the AC current of range up to 200A. |
| DC VOLTAGE = 12    | The device can measure the DC voltage of range up to 1000V. |
| DC CURRENT = 1.2   | The device can measure the DC current of range up to 10A. |
| RESISTANCE = 220   | The device can measure the resistance of range up to 2 Mega Ohms. |
| WIRE IS LIVE       | The live-wire test is done to detect the presence of live wire. |
| CIRCUIT IS CLOSED  | The connectivity test is done which checks whether the circuit is closed or open. |

5. **Future Enhancement**
The gloves which are integrated with the microcontroller and other components can also be implemented by manufacturing an application specific integrated circuit. It can be enhanced by integrating the circuit on the flexible insulated gloves itself. Thus, the device will be compact and so the complexity and bulk integration of components is over. A mobile application for monitoring...
these workers can also be created for easy monitoring. Besides, a database can be created for such gloves for monitoring all the workers in a huge project which needs hundreds of workers. All of their mental, physical health and their works can be thus monitored effectively. This can also be enhanced by connecting it with the database such that monitoring of health and their calibration of electrical parameters can be stored each. Therefore, the safety wearable can be made mandatory, so that minor accidents due to ignorance and lethargic attitude can be eliminated effectively.

6. Conclusion

The proposed model contains merits that overcomes the lethargic attitude towards safety conventions by integrating measuring equipment on that. Besides, the components are integrated and the counter counts the working hours. Thus, making the wearable mandatory while working on high tension wire. Thus, Smart electrician gloves could be the best product among all the products in electrician’s tool-kit. If these additional circuits are integrated very minutely on top of the flexible gloves then the product would be a boon. The gloves can be employed for various workers working in construction projects by the employment of work specific sensors and other components. Thus, the errors while working can be minimized effectively moreover the transparency in the calibration of an electrician can be accomplished so that their superior can note down all their measurements. So, Smart electrician gloves is one of the most needed devices now.

References

[1]. Kowalski E. L. Robert, Tomioka J, Teixeira Junior J. A’ Tosin J. C. 4, Clerise R.E, Otto Filho E, “Natural rubber Electrical Conduction under high and low electrical field”, IEEE, 2019

[2]. Dhivya V., Anandakumar H, and Sivakumar M, “An effective group formation in the cloud based on Ring signature,” 2015 IEEE 9th International Conference on Intelligent Systems and Control (ISCO), Jan. 2015. doi:10.1109/isco.2015.7282366

[3]. Haldorai and A. Ramu, “The Impact of Big Data Analytics and Challenges to Cyber Security,” Advances in Information Security, Privacy, and Ethics, pp. 300–314, 2018. doi:10.4018/978-1-5225-4100-4.ch016

[4]. Haldorai and U. Kandaswamy, “Dynamic Spectrum Handovers in Cognitive Radio Networks,” EAI/Springer Innovations in Communication and Computing, pp. 111–133, 2019.

[5]. PaülYanchapaxi, Christian Tipantiña, XavierCalderón, “Wearable system for monitoring of human physical activities”, IEEE, 2019

[6]. Sindhu K, Priya Sinha, Subashini R;“Sandesh Categorized Accident Alerting System using bike gloves”, International Conference on Vision Towards emerging Trends in Communication and Networking (VTTECoN), 2019.

[7]. R.Senthil Kumar, K.R.Sugavanam, S.Sri Krishna kumar, K.Rahul “Elimination of Electric Shocks through Dual Voltage Switching Supply System” International Journal of Engineering and Innovative Technology (IJEIT) Volume 3, Issue 6, pg no 222-227 December 2013 ISSN: 2277-3754

[8]. LuayFraiwan, TasnimBasnaji, Omnia Hassanin, “A Mobile Health Monitoring System: A smart glove”,14th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS), 2018

[9]. R.Senthil Kumar, K.R.Sugavanam, S.Jalaja, S.SriKrishna Kumar, A.L.Meenal, G.Chandni, “GSM Based Fully Automated Surveillance Ensuring Road Safety and Data Acquisition for Legal Prosecution” International Journal of Applied Engineering Research, Vol.10, No.1, pg no.145-157, Jan - 2015, ISSN: 1087-1090.

[10]. Foghel, Amir, Oded Hogeg, and Moshe Hogeg. "Car accident automatic emergency service alerting system," U.S. Patent Application 13/237,355, filed March 21, 2013.

[11]. S. Sri Krishna Kumar, G. Chandni, A.L Meenal, T.S.Kalaimohan, R.Senthil Kumar, K.R. Sugavanam, “BLE Enhanced decentralised Work Time sheet and Real Time Monitoring using Smart ID Card” ARPN Journal of Engineering and Applied Sciences, VOL. 10, NO. 18, pp8080-8084, 2015, ISSN 1819-6608.

[12]. Fleischer, Paul Benjamin, Atso Yao Nelson, Robert AdjetyetSowah, and AppahBremang. "Design and development of GPS/GSM based vehicle tracking and alert system for commercial inter-city buses." In Adaptive Science & Technology (ICAST), IEEE 4th International Conference on, pp. 1-6. IEEE, 2012.

[13]. Amin, Md Syedul, Jubayer Jalil, and M. B. I. Rea. "Accident detectionand reporting system using GPS, GPRS and GSM technology." In Informatics, Electronics & Vision (ICIEV), 2012 International Conference on, pp. 640-643. IEEE, 2012.