International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 12 Dec 2023, pp: 01-06 www.ijaem.net ISSN: 2395-5252

# RF based wearable metal detection glove for Industrial Based Test Bench

AravindBalaji[1], RathyG.A.[2], Sivasankar.P[3] Gunasekaran.K[4]
[1,] Research Scholar, Hindustan Institute of Science and Technology, Chennai
[2 3]Professor EECE, NITTTR Chennai.
AE,Electrical,NITTTR,Chennai
Rathy G.A :Corresponding author

Date of Submission: 06-12-2023 Date of Acceptance: 16-12-2023

**ABSTRACT**: In every manufacturing industry, the in-house material rejection, is one of the most common and inevitable process that has to be monitored and suppressed to provide a better yield and quality of the desired manufacturing product. The main cause of such rejection is due to poor handling of the product during the manufacturing process; these can be eliminated by providing a better exposure and assessment to the workers in handling and commissioning the product during the process of manufacturing.
The main objective of this work is to provide a test bench to improve the quality of product and process of manufacturing by assisting and monitoring the product handling capability. This is achieved by providing a mock test bench that evaluates and trains the material handling capability by monitoring the hand movements of the worker; a wireless wearable glove attached with the worker hands which aids to sense the touch of each fingers over the product during handling and commissioning and depending upon which the assessment is evaluated.
**Keywords:**RFID, wearable glove, Test bench, wireless, LabVIEW, Graphical Interface

## I. INTRODUCTION

In automobile industries during manufacturing process it is necessary to handle a lot of delicate products with much care during installation and commissioning. These products pass via lots of sub processes before they are "out for market". Most of these processes are either automated or semi-automated; automated processes are reducing human made damages considerably. In cases of semi-automated process, as it allows human intervention which paves way for mishandling the products; This leads to rejection of the product even after satisfying all thetechnical amenities of the products. This paper focuses on improvising the semi-automated process by proposing RF based wearable metal detection glove for industrial based test bench. The product tested is the radiators which is one ofthe finest and most importantpart ina cooling system. It is used to cool down engine in motorcycles.

Figure 1 (a) Radiator;1(b) Radiator with damaged fins

The Figure 1 (a) shows the radiator used in motorcycles to cool internal combustion engines; the centre part of the radiator consists of array of thin aluminium. Initially a coolant is passed over the engine which absorbs engine heat, then fed to inlet reservoir of radiator at one end and flow across tubes to reservoir at another end of the radiator. Since the heat coolant flows through the tubes between two sides of the radiator, the heat is transferred to the tubes from the coolant and from there it is transferred to thin aluminium fins passed in zigzag form over the tubes and thus the heat is dissipated to outer air. Thus, the flow cycle between the two ends of the radiator repeats and the heat is dissipated from the engine. Hence the aluminium fins play a vital role in the cooling system and it covers the major cross section area of the radiator.

Fins provide a great contact for tubes surface to the air for cooling. Figure 1(b) shows the radiator with damaged fins. The damage is due to human mishandling which leads to bends since they are fine and delicate. This bends in the fins due to human mishandling will block air contact with the tubes. This in turn increases the temperature of the engine and results in radiator failure. Hence it is important to reject such fin damages at the manufacture side before dispatching them to market. When it comes to mass production, the detection of fin damages during the sub processes of the radiator manufacturing is crucial and difficult. Hence it is important to develop a mock test bench to monitor and evaluate the handling of the radiator during each process and examine whether the radiators are handled with care and the quality of the manufacturing is ensured.

The test bench is equipped with a sensing and a monitoring unit; the sensing unit consist of a wearable glove with metal detecting sensor on all the fingers; these sensors output data are transferred to the monitoring unit using wireless communication (i.e.) RF transmitter and receiver;

The received sensor output from the sensing unit will be evaluated using the monitoring unit to detect and reject the fin damages due to human mishandling during the sub processes of radiator manufacturing so that the quality is ensured.

## II.REVIEW OF LITERATURE

Ma, G., Lu, J., & Gao, M. (2018) developed a Metal detection system using HMC1001 magnetic sensor module with data acquisition system with higher sensitive rate. It used anisotropic magneto resistance effort due to change resistance with respect to current and magnetic movement. The detection was based on comparison of threshold value with a set of samples.

Majumdhar.S (2017) proposed that wearable devices can monitor and record real-time information about one's physiological condition and motion activities. Wearable sensor-based health monitoring systems may comprise different types of flexible sensors that can be integrated into textile fibre, clothes, and elastic bands or directly attached to the human body. The wearable health monitoring systems are usually equipped with a variety of electronic and MEMS sensors, actuators, wireless communication modules and signal processing units. The measurements obtained by the sensors connected in a wireless Body Sensor Network (BSN) are transmitted to a nearby processing node using a suitable communication protocol, preferably a low-power and short-range wireless medium, for example, Bluetooth, ZigBee, and Near Field Communications (NFC).

Mutha, V. R., Kumar, N., &Pareek, P. (2016). Developed a standalone data acquisition system using microcontroller which was interfaced with LabVIEW to provide the graphical user interface, the sensor data was transferred using Wi-Fi communication.

Wenjun Li, Hui Liu, &Liye He. (2015) developed a remote wireless meter – reading system based on RF 433Mhz wireless technology based communication system and GPRS to get the data to server. The RF 433Mhz module is used for internal communication within the system.

Phi, L. T., Nguyen, H. D., Bui, T. T. Q., & Vu, T. T. (2015) developed Glove based gesture recognition using flex sensor which was used to sense the movement by connecting flux sensor on each fingers. Flux sensor work on the principle of change in resistance due to bend.A sensor glove is attached with ten flex sensors and one accelerometer. Here, flex sensors are used for sensing the curvature of fingers and the accelerometer is used in detecting a movement of a hand.

Schmidt et al. (2013) pioneered the idea of integrating an RFID reader into a glove so that tags on objects touched by the glove can be detected by the embedded reader. However, their system comprised a heavy glove, with wires for power and communications leading to a hip-mounted power unit/reader that was further connected to a "wearable computer" that processed the data.

Kenneth. P (2005) presents a practical system for enabling applications such as health monitoring, factory-floor maintenance and context-sensitive reminders needs to detect touches of many objects of many types, distinguish between instances of the same object type, and be accurate; thus benefit from awareness of objects used. Radio Frequency Identification (RFID) tags can return a unique identifier to a nearby scanning reader even without direct line of sight. For the RFID sensor, SkyeTek M1 13.56MHz reader was used. 13.56MHz tags are available off-the shelf, are inexpensive, and have a small, postage-stamp size form factor. Using the M1 allows us to add only minimal "glue" logic (a voltage regulator and an additional level converter) to interface this board with the rest of our reader system

From the literature survey, it is observed that these techniques can be implemented within a specific platform to provide a better and reliable test bench with customized metal touch sensor module to provide high accuracy and sensitive over thin aluminium fins.

## III.DESIGN ARCHITECTURE

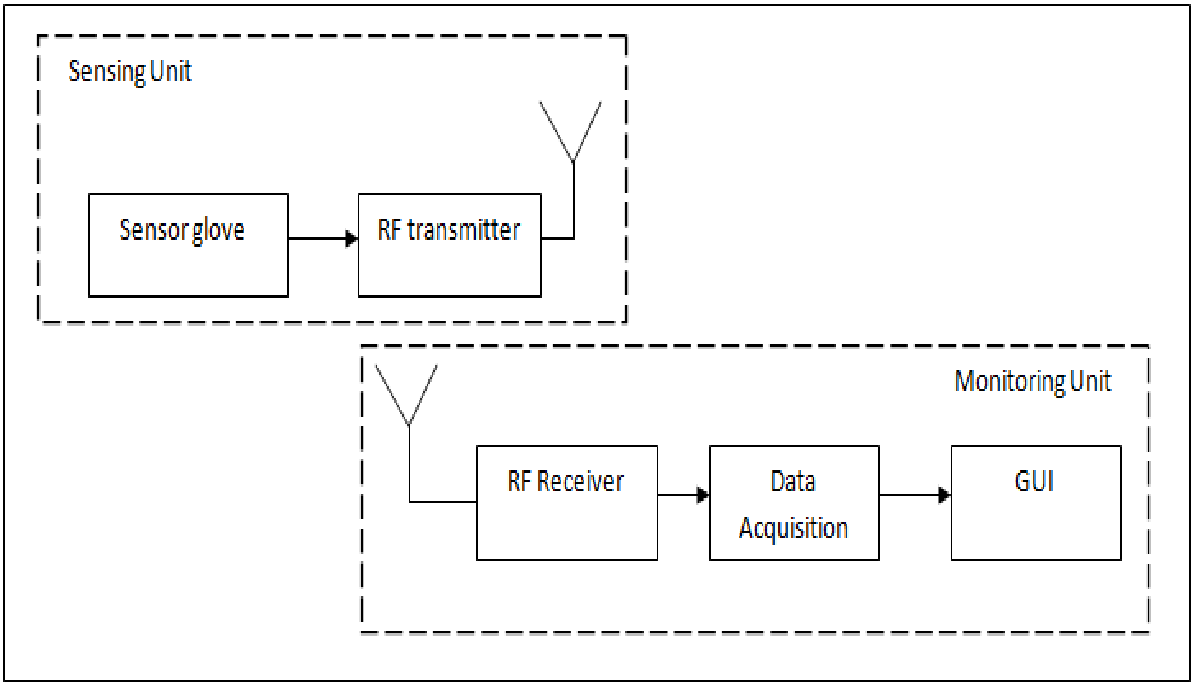


Figure 2 Design architecture

The Figure 2 shows the design architecture of the proposed RF based wearable metal detection glove for industrial based test bench; The proposed design architecture consists of two units namely the sensing unit and monitoring unit. Sensing unit will sense the touch in the sensitive area and transmit the sensed information to the monitoring unit. The monitoring unit will receive the sensed information transmitted by the sensing unit; The Data Acquisition system within the monitoring unit will interact with the Graphical user interface (GUI) which indicates the monitoring process. The communication between the sensing and monitoring unit is achieved through the RF communication via transmitter of the sensing unit and receiver of the receiving unit. The details of the components of the sensing and monitoring unit of the proposed system is elaborated in the following sections.

a. Sensing unit

Sensing unit of the proposed system consists of Sensor glove and RF Transmitter. The main part of the Sensor glove is Metal sensor module which has an objective to overcome the human mishandling of the fins in the radiator during its manufacturing process. Hence it is essential to carefully design the metal sensor module to efficiently handle the parts and minimize the damages to the fins. The Metal sensor module is especially designed with flex printed circuit boards and copper coated two tracks that are traced in parallel to each other with two end terminals.

The simple principle behind the metal sensor module is that whenever it comes in contact with any metal surface, two end terminals are shorted. When the terminals are shorted, a pulse will be generated to indicate the short. This principle of generating the pulse will aid to detect the mishandling of human errors, which in turn train the human to minimize the mishandlings

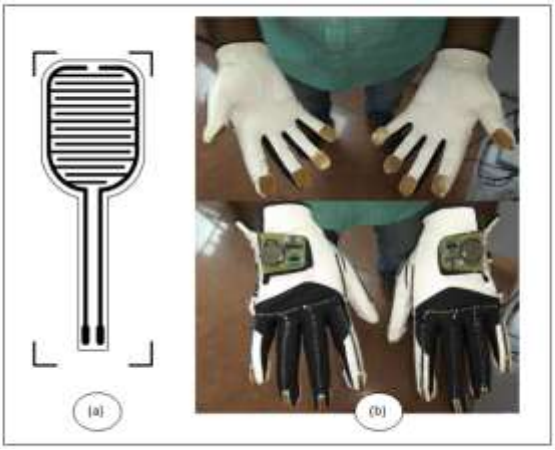


Figure 3 (a) Metal sensor module (b)sensor glove top and bottom view

b. 433Mhz RF Transmitter and receiver

RF transmitter transmits serial data at a frequency of 433Mhz and covers a wider range of upto 300 feet (91 meters) when RF compared to other wireless protocol such a Bluetooth and alsosignal can be transmitted and received even when there is obstacle in-between. The RF transmitter encodes the serial data using Amplitude shift keying method, this is achieved using saw resonator which is tuned to 433Mhz and is encoded with the data using switching transistor and transmitted. Due to its low power consumption a Cmos 3.3V battery is attached to the circuit to provide the power to the central transmitter circuitry. On the other hand the receiver receives the signal and decodes it wing phase lock loop method and send it to the data acquisition system.

## VI. DATA ACQUISITION SYSTEM

A data acquisition system is combination of hardware and software-based architecture that enables the user to measure or controls the physical phenomenal of any real time signal. Here the sensor data is acquired from the RF receiver and are processed for evaluation. The hardware consists of anATmega328 microcontroller which acquires the incoming data and indicate the touch detection count using 7 segment display and timer indication to show the elapse time. The controller also communicates with the PC using Ethernet TCP/IP protocol which makes it to connect over any network and sends the data to the pc and indicates the touch detection using a Graphical User Interface (GUI) which automatically logs the data in excel sheet. The controller controls and communicates with both the hardware as well as the GUI simultaneously. These data are compared for evaluation.

## V. EVALUATION FLOW CHART

The flow chart above shows the evaluation process of the test bench. Initially during a sub process of the radiator, it is monitored for a period if the fingers touches the sensitive area such as the aluminium fins using the mental sensor module fixed at ends of each fingers. A real time timer is turned on and checks if an touch is detected and if detected then a counter is increment by one indicating the touch detection on the sensitive area. This process is repeated until the timer ends. Once the timer is ended the counter value is check if it is less than one which means the test is pass else the counter value is indicated with fail status. Figure 4. explains the evaluation process of test bench.

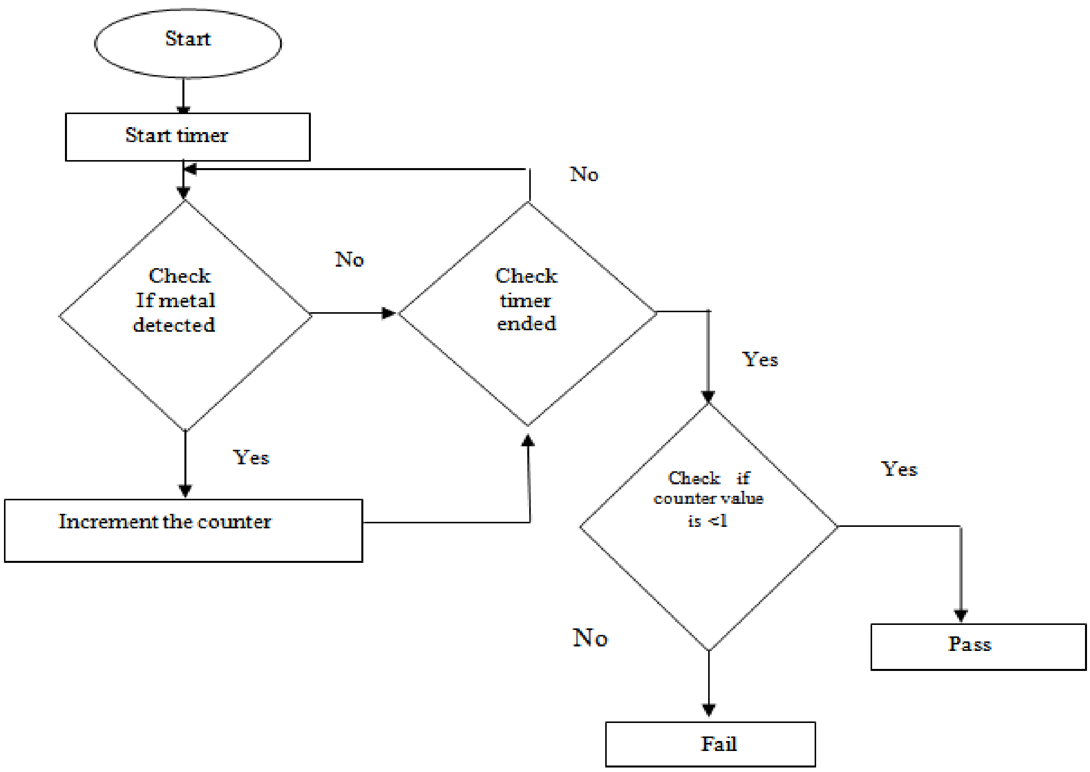


Figure 4. Flowchart of evaluation process of test bench

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 12 Dec 2023, pp: 01-06 www.ijaem.net ISSN: 2395-5252

The graphical user interface provides the data logging process by getting the data from the data acquisition system via ethernet protocol and log them in excel sheet or csv file. the GUI consists of fill forms to be filled to register the details of the user to be evaluated. The date and time are automatically logged in excel sheet using time stamping method. Test status are indicated using virtual led which indicates the status of the test after evaluation.

## VI.RESULT

The figure given shows the output result of the test bench in which fig5(a) represents the hardware control and indication which indicates the count of both hands whereas the fig 5(b) shows the Graphical

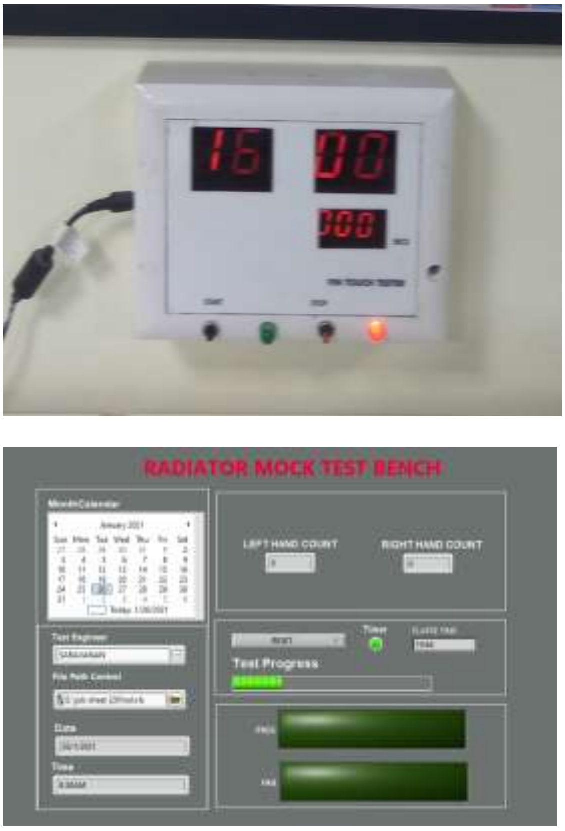


Figure 5 (a) Output module;5 (b)Graphical User Interface

user interface. Initially the test engineer details are filled and the excel sheet path is added for data logging and the test process is started along with timer. Separate indicators are provided for both left
and right hands which will indicate the number of counts the fingers comes in contact with the sensitive area finally once the timer ends the test status is indicated whether pass or fail.

## REFERENCES

[1]. Majumder S, Mondal T, Deen MJ. Wearable Sensors for Remote Health Monitoring. Sensors. 2017; 17(1):130. https://doi.org/10.3390/s17010130

[2]. Fishkin, K., Philipose, M., & Rea, A.D. (2005). Hands-on RFID: wireless wearables

[3]. for detecting use of objects. Ninth IEEE International Symposium on Wearable Computers (ISWC'05), 38-41.

[4]. A. Schmidt, H-W. Gellersen and C. Merz. “Enabling Implicit Human Computer Interaction - A Wearable RFID-Tag Reader”. ISWC2000, 2013, pp193-194

[5]. sensor. 2018 13th IEEE Conference on Industrial Electronics and Applications (ICIEA). doi:10.1109/iciea.2018.8397984

[6]. Wenjun Li, Hui Liu, &Liye He. (2015). Remote wireless meter-reading system based on the 433MHz and GPRS technology. 2015 IEEE 16th International

Conference on Communication Technology (ICCT). doi:10.1109/icct.2015.7399802

[7]. Phi, L. T., Nguyen, H. D., Bui, T. T. Q., & Vu, T. T. (2015). A glove-based gesture recognition system for Vietnamese sign language. 2015 15th International Conference on Control, Automation and Systems (ICCAS). doi:10.1109/iccas.2015.7364604

[8]. Mutha, V. R., Kumar, N., &Pareek, P. (2016). Real time standalone data acquisition system for environmental data. 2016 IEEE 1st International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES). doi:10.1109/icpeices.2016.7853337

[9]. A.Ganiand M. J. E. Salami "A LabVIEW based data acquisition system for vibration monitoring and analysis" Student conference on Research and Development, 2002. SCOReD 2002. Pp 62-65

[10]. Zhang Xueyong, Zhao Qun, Li Yibao Design of a Metal Detector Journal of Anhui Institute of Architecture and Technology (Natural Science Edition), 2007 (3): 45-46.