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Identification of Type of Metals by Using Heat Transfer Rate

V. Karthikeyan[1], Arunraj L R[2], Premkumar M[3], Raghuram RK [4], Saundara rajan R[5]
[1]*Assistant Professor,* [2, 3, 4, 5]*Under Graduate Student, Department of Mechanical Engineering, VSB College of Engineering Technical Campus*

Abstract: ***Metals are advances in manufacturing processes which is the industrial revolution. It is very important to accurately identify types of metal when working with metal materials, and this is particularly important in maintenance welding. Metals with higher carbon content are sensitive to hot-cracking and hardening, which can result in poor ductility for welding projects. If it want to be simply identify a piece of scrap metal, it can be done by evaluating its colour, weight and composition. The common ways to identify metal is surface appearance, spark test, chip test, magnet test, hardness test. Project is to identifying metals based on their heat rate from one end to another end through a instrument automatically. This is because of electron arrangement in them.***
Initially the metal piece is heated in one end and the heat is transferred to another end which is sensed by the heat sensor and when heat sensor activated the time sensor record the time is calculated by a heat transfer rate thermodynamic formula and then the metal type is get identified.
The main advantage of this device is small and compact and also easy to operate. More than 1000 metal samples can be updated in the Arduino MAX6675.
Keywords: Heat transfer rate, Temperature difference, Electron arrangement

I. INTRODUCTION

Metal identification device is used to identify the different types of metal by the help of Heat transfer rate of different metal. This device is made up of various part such as heating coil, metal piece which should be tested, temperature sensor, Arduino board, display. Initially the heating coil is heated of metal piece which should be tested and then the heat is transferred from one end to another end in the certain amount of time which is get noted and then the temperature value is shown in temperature sensor. Now the two values are carried out to Arduino board which calculate the value and then by checking corresponding value in table of content and then the metal type will be identified.

Initially the sample metal piece heated by coil which is operated by electric current which make temperature rise the metal piece and then the temperature rise is sensed by temperature sensor. This sensed temperature value is transferred to Arduino board and the timing of heat transfer from one end of the metal to another end is noted. And then the value of the area is measured after measuring.

The value is entered to the Arduino software and then the value obtained through software is made check with the table of content inbuilt with the software.

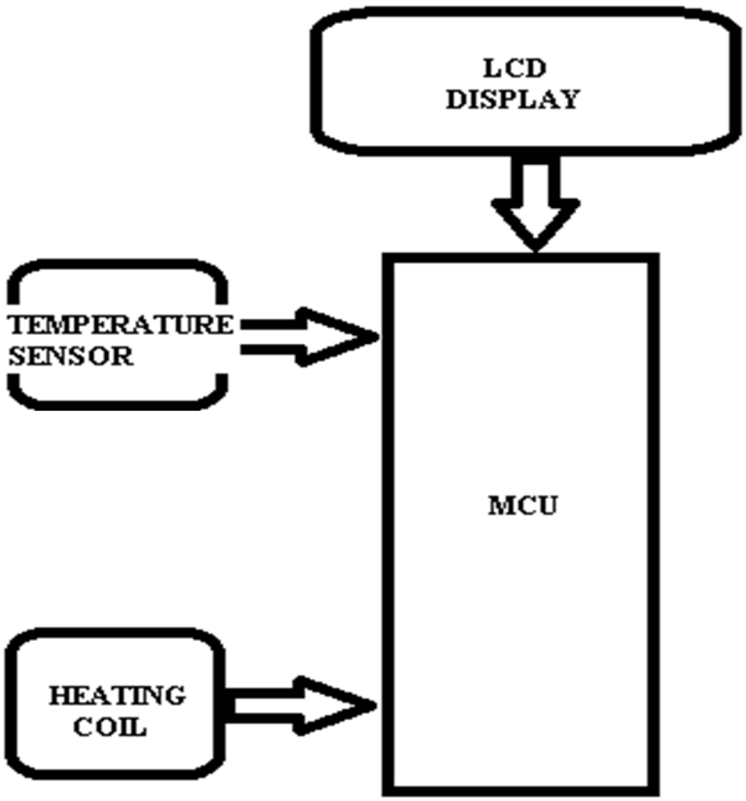
Finally using the value obtained metals can specifically identify the type of metal. In real time world it is mainly used in welding section to make easy identification of metal. And it also used in research purpose to identify Heat transfer rate of different metals. It is very compact to handle the device and so it will be operated easily.

II. MATERIALS AND METHODS

This section explains the materials and methods used for designing the components of metal identification device using Heat transfer rate.

This device is composed of two heating coil, transformer, Arduino board, LCD display, metal stand and thermistor. This project is mainly focused on identifying the type of metal through Heat transfer rate to help welding workers to easily identify the metal type and also Heat transfer rate of every metal by sample piece. It is also used to research metals heat conductivity and Heat transfer rate by this device.

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A. Conceptual Design

Conceptual design plays a vital role in designing a product. It is the point within the development cycle that typically sites between the products requirements and detailed design. The required design of the components to fabricate the identification of metals type device

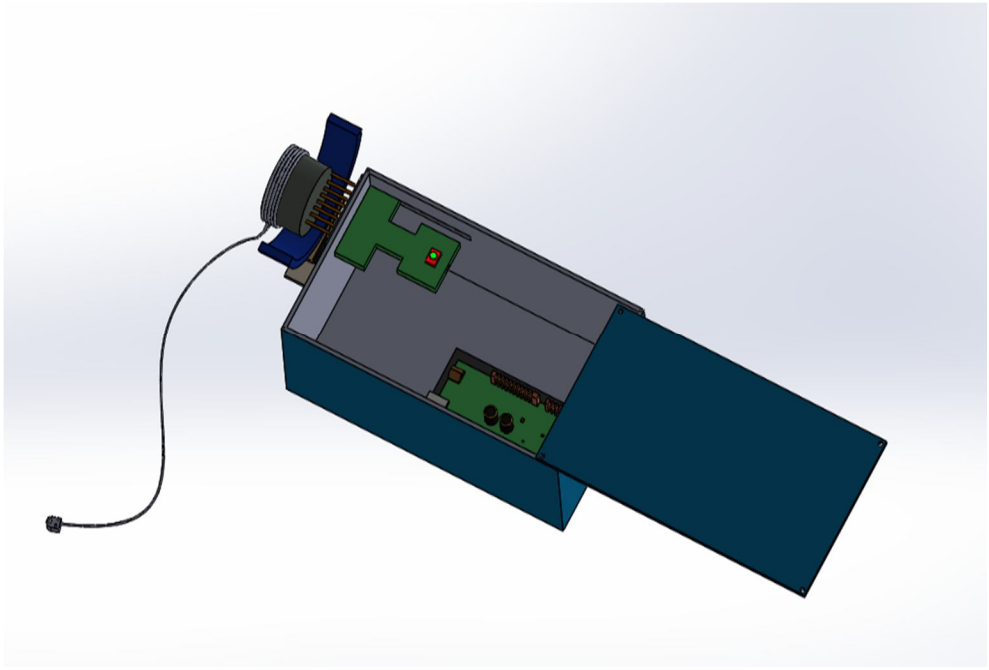


Fig 1. Conceptual Design

B. Components of the Conceptual Design

1) Heating coil
2) Temperature sensor
3) Transformer
4) Arduino UNO board
5) LCD display
6) Material fixing stand

III. RESULT AND DISCUSSION

A. Calculation of Heat transfer rate Q

One dimensional steady state heat transfer

$$Q = \frac{\Delta T overall}{R}$$

$$R = \frac{1}{2\pi KL} * \ln(r)$$

$$Q = \frac{2\pi LK\Delta T}{\ln(r)}$$

B. Heat transfer rate for copper

Length =0.065m
Thermal conductivity = 379.15 W/mk
Initial Temp = 130 degree
Final Temp = 42.2 degree
Q = $2\pi * 0.065 * 379.15 * \frac{(130-42.2)}{\ln(0.75)}$
Q = 47259.16 W/mk

C. Heat transfer rate of aluminum

Length =0.065m
Thermal conductivity = 206.86 W/mk
Initial Temp = 130 degree
Final Temp = 37.75 degree
Q = $2\pi * 0.065 * 206.86 * \frac{(130-37.75)}{\ln(0.75)}$
Q = 25006.97 W/mk

D. Heat transfer rate of stainless steel

Length =0.065m
Thermal conductivity = 17.3 W/mk
Initial Temp = 130 degree
Final Temp = 29 degree
Q = $2\pi * 0.065 * 17.3 * \frac{(130-29)}{\ln(0.75)}$
Q = 2480.54 W/m

E. Heat transfer rate value of tested metal

Sl.no	Material	Heat transfer rate Q (W/mk)
1	Copper	47259.16
2	Aluminum	25006.97
3	Stainless steel	2480.54

F. Method study

The project involves identification of different metal type by Heat transfer rate. The identification of different metal type by Heat transfer rate.

Tested value of four metal

Sl no.	Metals	Heat transfer rate	Test 1	Test 2	Test 3	Test 4	Average
1	Copper	379.15	41.9	42.3	42.5	42.3	42.2
2	Aluminum	206.86	36.8	38.3	38	38	38
4	Stainless steel	37.775	29.5	29.75	29.5	29.6	29.5

Values of Heat transfer rate K is referred from HMT Databook by interpolation method

Since this is new concept still in research and not yet developed. The main reason to develop this device is to identify the type of metal which in welding section , research of material and metal. To inbuilt the values of different metal's Heat transfer rate is tested and values are inserted in the program coding as the range within 20 seconds. Through this 20 seconds gap the heat transfer from one end of the metal piece to another end. Temperature sensor(110w) thermistor is used in sensing of the heat transferred from the T1 and final temperature is considered as T2. This device is built in low cost and efficient manner. Arduino plays important role in this device which helps in identifying the material automatically. Where Arduino MAX6675 is the model used in this device to make the program to run in enhanced transmission speed.

Graphical Representation Of Results



IV. SUMMARY

The industry was in need of increasing its productivity and also precision. As per lean six sigma when accuracy is get increased the sales of the product will be increased. To accurately identify the metals type this device is one of the choice. The summary & conclusion of the whole project with the benefits are discussed in this chapter.The main objective of the project is to develop the low-cost device for identification of different metals using heat transfer process and Arduino board. And by using this device the Heat transfer rate of every metals can be tested which is useful in research and studies about metals which helps in identifying the strength and structure of the metals. Hence it is small in size and compact transferring from one place to another place is easily achieved. Decreasing of wasting material is achieved by using only sample piece. Identification of type of metal by Heat transfer rate automatically by Arduino board enables students and welders to experience real time issue of metal identification is made easy through this device. Through is device study metals and materials were made easy and accurate. It is very small size where it is carried by user easily.

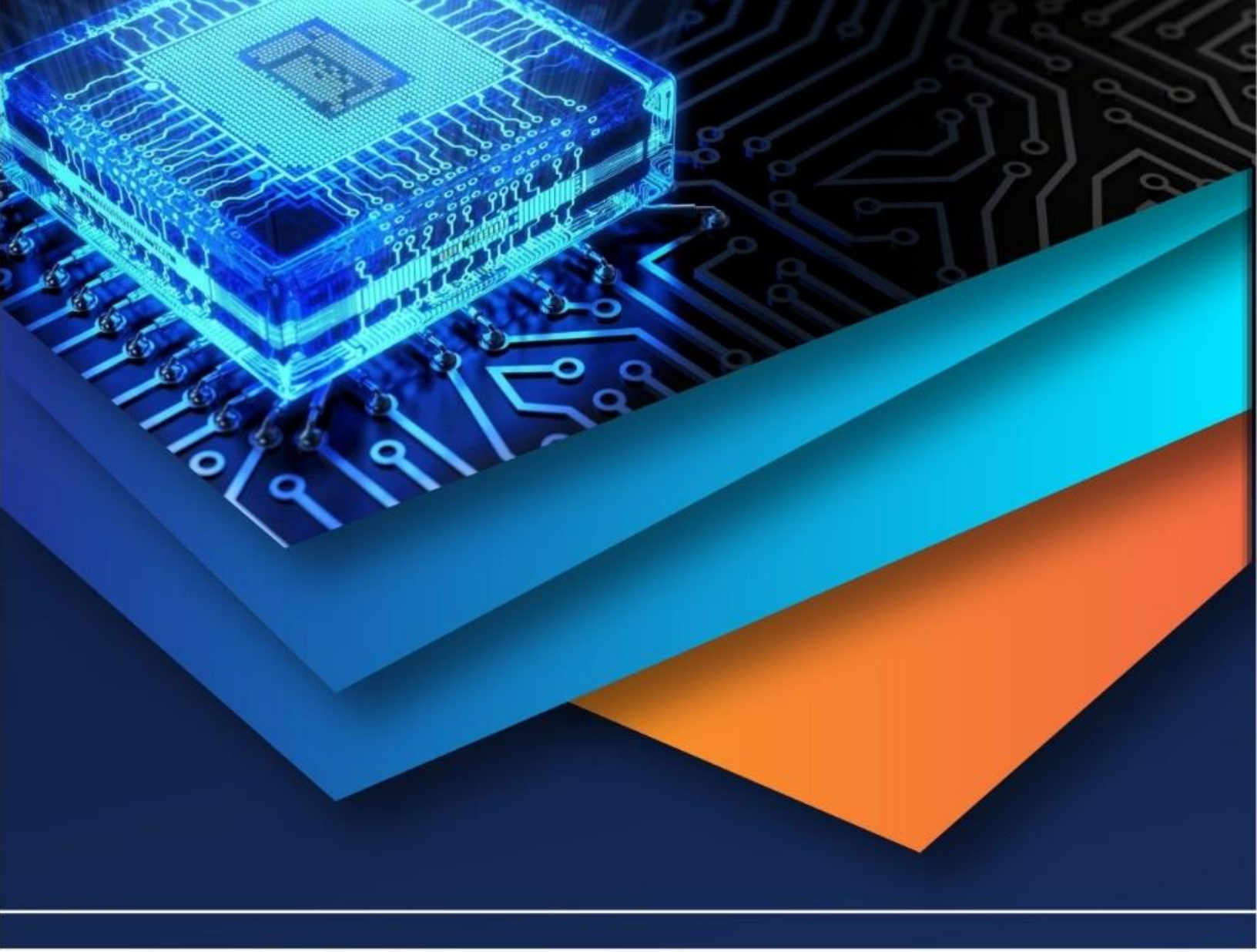
V. CONCLUSION

Hence by using this project the problem faced by welders is rectified and it works good in real time applications. After finishing this project it can be concluded that it is new innovative project to identify the metal among various methods like spark test, magnetic test, hardness test, and chip test. When compared to these methods identification of metals by using Heat transfer rate simple and easy to use. \

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