International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 12 | Dec -2016 www.irjet.net p-ISSN: 2395-0072

Design and Implementation of an Electronic System for Identification of Rebars in Reinforced Concrete.

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Abstract – *In this paper non-destructive method is implemented in which magnetic self-designed sensor is used to detect position of rebar in reinforced concrete. During the renovation of old buildings it is necessary to locate rebar accurately to avoid damages in construction. This is achieved by Magnetic sensor which is made up of E-shaped core also primary and secondary windings. Due to presence of rebar output of sensor varies. Rotary encoder is used to measure distance between rebar. Display is used to display results. This is portable device that you have to move on wall or column for desired output.*

Key Words: *Arduino mega, Rotary encoder, Magnetic sensor, SD Card module*.

1. INTRODUCTION

To inspect the rebar using ant non-destructive method has been a challenging task, especially since they are embedded in prestressed concrete. Visual inspection is not efficient and useful method as it fails to locate rebar accurately. Magnetic sensor used for locating reinforcing steel present within in concrete work on the principle that the steel affects the alternating magnetic field. So this paper discusses development of system by utilizing maximum possible information from magnetic effect on rebar.

A E-shaped electromagnet-sensor was designed to magnetize strands and when this hand-held search unit is moved along the concrete surface it results variations in output voltage of secondary of sensor resulting indication of presence of rebar.

2. OVERVIEW OF SYSTEM

The proposed system mainly involves two steps. First step is detection of presence of rebar and second step is measuring the distance. Presence of rebar is detected by using self-made magnetic sensor and distance is measured by using rotary encoder with ppr 24.System is based on Arduino mega board. Arduino is microcontroller, which will run the predefined program to process input/output on its GPIO pins. Better than Raspberry Pi, Arduino has some GPIO pins that could accept analog input, and has several (usually 6) GPIO pins .That is used to convert analog i/p to digital O/P. The communication between the microcontroller and the SD card module uses SPI, which takes place on digital pins 50, 51, and 52.

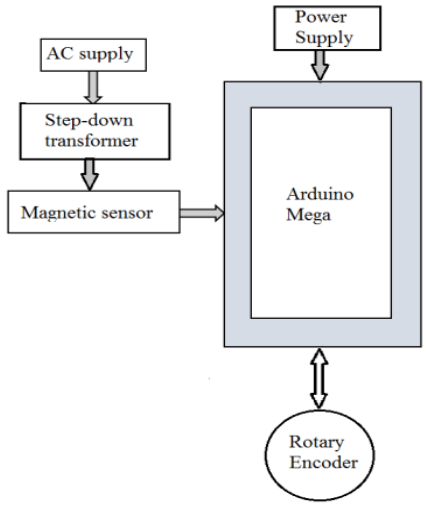

Fig. 1. Block Diagram of system

Input to magnetic sensor is AC voltage. Here step-up as well as step-down of voltage is carried out so as to get desired results. Ac voltage is given to step-down transformer then its output is given to magnetic sensor which contains two windings i.e. primary and secondary winding. Number of turns of primary and secondary are calculated such that it acts as step-up transformer.

As distance between this sensor and rebar varies the output of secondary which is inversely proportional to distance. MATLAB is used to display results in the form of bar graph.

A. Interfacing rotary encoder to Arduino mega

Rotary encoder is device that is used to convert rotary displacement into digital pulse. It has two output channels (A and B) to sense the position .The output of these two signals are 90 degree out of phase with respect to each other. From these signals we can find out position and direction of rotation, if A leads B then disk is rotating in a clockwise direction and if B leads A then disk is rotating in counterclockwise direction. Output of encoder is equivalent to 1,024 pulses per revolution. Following formulae is used to calculate linear distance travelled by disk, Linear distance covered = (output of encoder *3.1416*diameter of disk)/PPR of encoder.

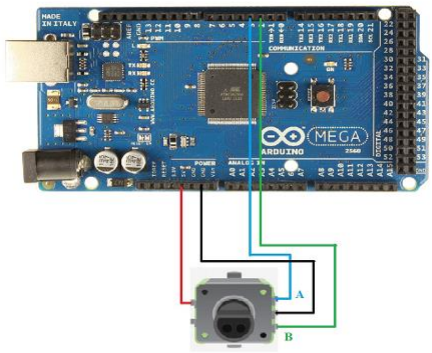

Fig. 2. Rotary Encoder

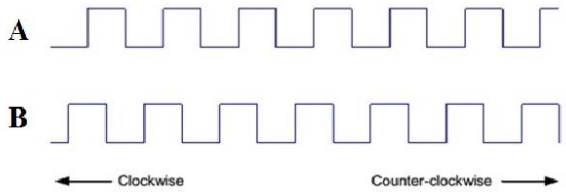

Fig. 3. Rotary encoder output

B. Magnetic Sensor

Magnetic sensor is designed which works on the principle of mutual induction of two coils and magnetic flux leakage. Principle of mutual induction - The production of an electromotive force in a circuit by a change in the current in an adjacent circuit which is linked to the first by the flux lines of a magnetic field. Magnetic flux leakage - The basic principle is that a powerful magnet is used to magnetize the steel Working principle of sensor - Output voltage produced in secondary winding as effect of primary windings due to mutual induction , varies according to presence of rebar. So, by observing output voltage of magnetic sensor we can find out rebar presence.

Design of sensor- *Steps to design of sensor is similar to transformer design steps. E-shaped core is used, there is primary and secondary windings are made such as step-up of input is done.*

STEP 1: Calculating the Core Area (CA) of sensor
STEP 2: Primary Winding Calculations
STEP 3: Secondary Winding Calculations
STEP 4: Calculating the Core Size of the Steel Laminations or the Stampings

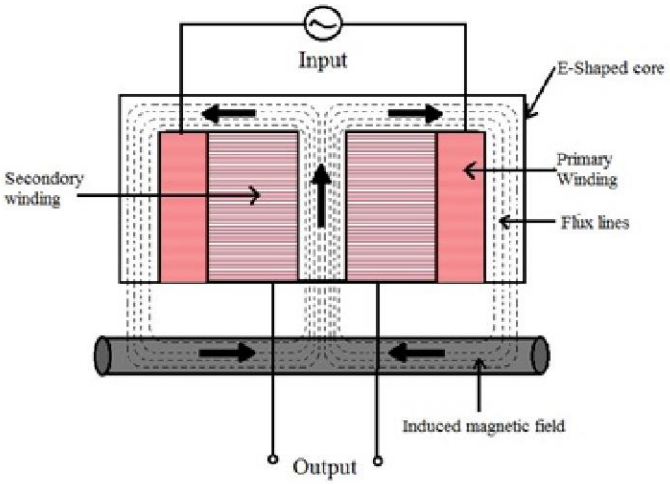

Fig. 4. Magnetic Sensor

C. Interfacing SD Card module to Arduino mega

Interfacing SD Card with Arduino Mega 2560 using SD Card Module you need to connect CS pin of SD module and Change SD pin in programming to which it is connected. In the program we have connected CS pin of Module with D53 (SS)

Table -1: Pin Specification of SD Card Module and Arduino Mega 2560

SD Card Module	Arduino Mega 2560
Gnd	GND
MISO	D50(MISO)
SCK	D52 (SCK)
MOSI	D51 (MOSI)
CS	D53 (SS)
+5	+5V
+3.3	N.C
GND	N.C

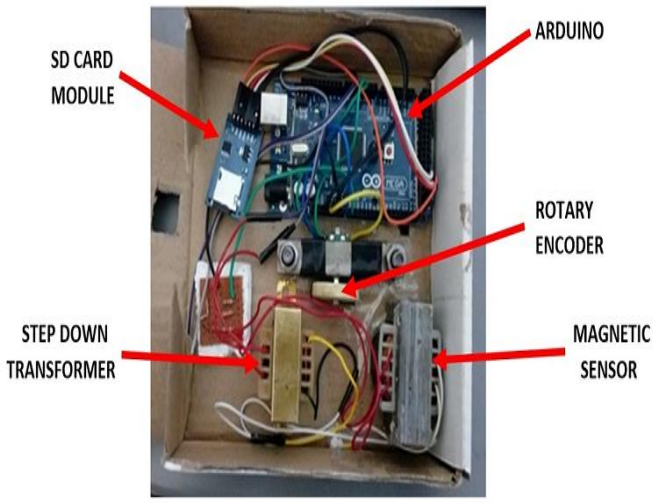

Fig 6 Front side of system

Fig 7 Back side of system

3. Flow Chart of System

As system starts its operation it reads data from magnetic sensor and rotary encoder and this procedure continues until and unless there is any change in the output of rotary encoder. Once output of rotary encoder varies then there is call to the interrupt for reading data from magnetic sensor. All this data is simultaneously stored in the SD card in the form of text document.Matlab GUI is also used to display the same results in the form of BAR graph. This output in matlab is real time.

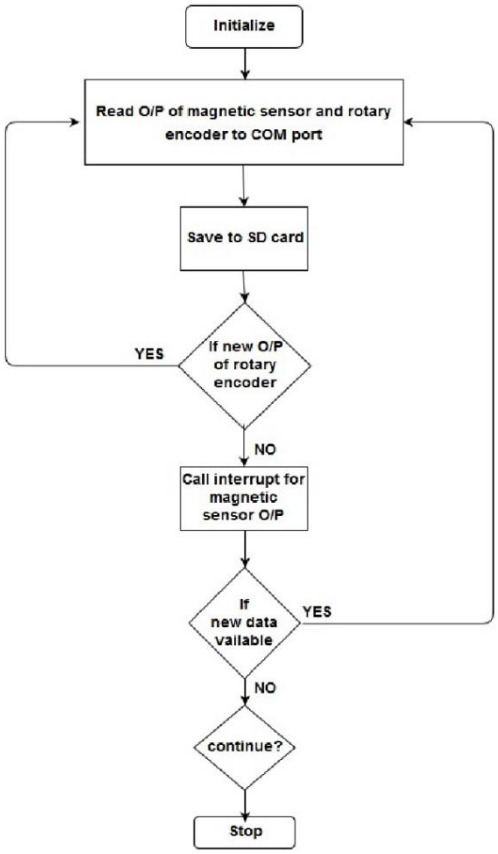

Fig. 8 Flow Chart

4. Experimental Results

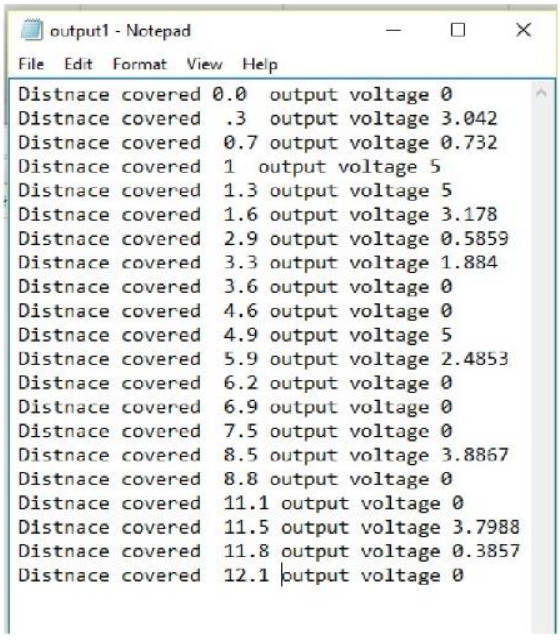

Fig. 9. Output

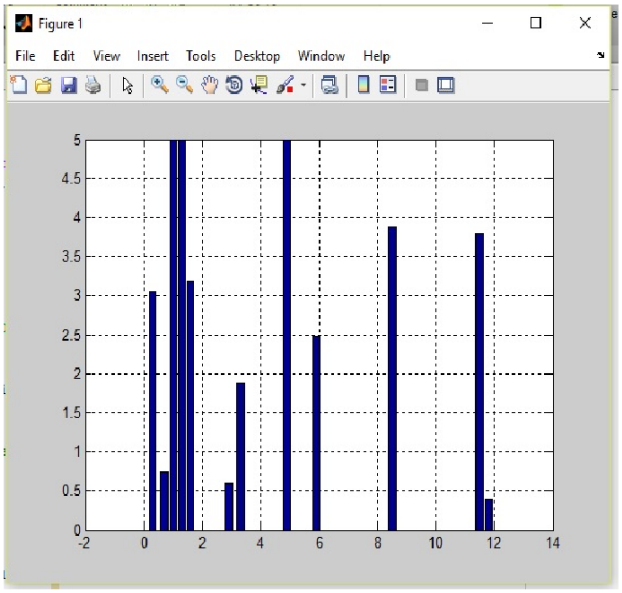

Fig. 10. Bar Graph Plot

Matlab is used to import numeric output data from text Files which is saved in SD card module. Bar graph is plotted by using system output.

5. Conclusions

The paper is based on the development of electronic system hardware setup for the implementation of rebar position detection in prestressed concrete. Principle of mutual induction and Magnetic flux leakage are used to develop sensor. Here I implemented electronic system in which Magnetic sensor and rotary encoder gives effective output that we are able to detect the exact position of rebar. Rebar is detected at depth of 25 to 30mm.Resoluton for distance between rebar is 3.2mm.

References

[1] Tomography Katarzyna Biernat, Alicja Idziaszekgonzalez, Konrad Nita, Stefan Wjtowicz, "Estimating Parameters Of Rebars In Concrete Employing Noninvasive Electromagnetic", *Electro technical Institute, Warsaw, Poland*.

[2] "Bridge Deck Survey With High Resolution Ground Penetrating Radar",14th *International conference on ground penetrating radar(GPR)*, June 4-8, 2012,Shanghai china @ISBN 978- 1-4673-2663-6..

[3] Bertrand Fernandes, "Development Of A Magnetic Field Sensor System For Nondestructive Evaluation Of Reinforcing Steel In Prestressed Concrete Ridge Members ", *The University of Toledo*, ,2012.

[4] Llus Jofre, Fellow and Maria Q. Feng, "Analysis Of The Electromagnetic Signature Of Reinforced Concrete Structures For Nondestructive Evaluation Of Corrosion Damage", *IEEE transactions on instrumentation and measurement*, vol. 61, no. 4, April 2012 vol. 61, no. 4, April 2012.

[5] P. Kaur; K. J. Dana; F. A. Romero; N. Gucunski, "Automated Gpr Rebar Analysis For Robotic Bridge Deck Evaluation", *in IEEE Transactions on Cybernetics.*