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Development of an Electronic Weighing Indicator for Digital Measurement

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Abstract : ***This paper presents the development of an electronic weighing indicator for digital measurement. The objectives of the system were to read weight measured in the conventional analog form to digital form, achieve high precision in measurement and calibration. This components used for this research are Load Cell, Hx711 Load Cell amplifier, Arduino Uno Microcontroller, and an LCD module. In this research, a 40kg load cell is used. The load cell sends output signals of the mechanical weights measured to the Hx711 module which amplifies and sends the output to the arduino microcontroller. The microcontroller calibrates the output signal with the aid of the load cell amplifier module before sending the signal which is already converted to digital form to the LCD module for display. The system developed has proved that a digital electronic weighing system can be low cost, miniaturized, detached and can take accurate readings devoid of errors***

Keywords: Conventional, Analog, Digital, Precision, Calibration, Load Cell, Microcontroller, Arduino, Mechanical.

1. INTRODUCTION

Demands of digital weighing machines are on the increase for businesses that deal on measuring items because it gives the precise and exact measurements of weights of objects [2]. The digital weighing machine gives a high accuracy and efficiency in measuring weights of items and this brings about satisfaction to the producer/seller and the buyer. Sensing devices such as transducer load cells are employed in analog weight scales. These weight scales do not utilize digital processors and they are read in an analog manner. These analog weight scales utilize a rotating pointer which rotates. There are disadvantages to the analog weighing indicator which are high power consumption because the actuators are electro-mechanical in nature. The actuator works with high current, low resolution which is caused by the fact that there are little differences in the weight of various objects which are not easily detected and the efficiency of the analog weight scale is low due to the rotating pointer which always shakes or moves. A digital weighing machine was developed which is used to measure weights ranging from 0kg to 40kg which is very accurate [1]. The electronic digital weight indicator developed utilizes the following; Arduino Uno microcontroller, a 40kg Load cell, an HX711 Load cell Amplifier Module and a 16x2 LCD.

2. LITERATURE REVIEW

Load cell was used to sense weights of objects by [1], the load cells worked as sensors. When load was applied on the load column, it was compressed while its length changed. The column acted like a primary transducer because the force applied was converted to change in length. The length change, was not directly measured while the strain gauge connected to the column for the load got compressed. While the load column acted as a primary transducer, the strain gauge acted as a secondary transducer because it recorded the displacement of the load column. While the strain gauge got compressed, its length changed depending on the magnitude of force applied to the top of the load cell. The resistance of the strain gauge changed when there was a change in its length. Resistance change was measured in terms of output voltage change and could be amplified using a differential amplifier. When the voltage

became negative, it was made positive by the inverter therefore, the load cell gave a voltage level which was equivalent to the applied weight.

[2] discussed on load cell development based on a static weighing system which focused on the use of digital filtering techniques which was used to remove low frequency noise during measurement from the static weighing system. This design had a high resolution measurement. A PGA was also included in the analog to digital converter coupled with the high resolution; this eliminated the need for a signal conditioning circuit. The analog to digital converter was interfaced directly with a precision sensor and was accessed by the microcontroller which enhanced measurement. This designed system had an accurate and high precision in output.

[3] presented the design of an efficient and inexpensive microcontroller based weighing scale. The load cell/resistive strain gauge was used to measure weight. Pressure was converted into various voltage levels. The voltage levels in this design were converted into digital data in the PIC16F690 microcontroller. This digital data was then displayed on a 16*2 liquid crystal display. The aim of this design was to give room for low cost, high precision user friendly functionalities which were all achieved.

[4] described the design and implementation of a digital electronic weighing system which is high resolution, portable and low cost. The designed system could be used in laboratory, for commercial and domestic purposes. This system has miniaturized circuits which made use of a microcontroller. It is made up of an 8 bit 8051 microcontroller which had a memory module for storing data from analog to digital converter. A programme was designed to interface the serial 10 bit ADC to the 8 bit microcontroller thus achieving High resolution without compromising range. The developed weighing system displayed the mass placed on the single point load cell on the LCD, senses and measures. The weights measured weights on this system ranges between 0-19kg.

[5] got analogue weighing machine and converted it to a digital weighing machine. This was achieved using the spring extension in the analog weighing machine was converted by a voltage divider circuit (transducer) into voltage. The transducer (voltage divider) output was fed to the microcontroller which was responsible for converting analog voltages to its digital equivalent using the analog-digital converter embedded into the microcontroller. The microcontroller was programmed to display the mass and the corresponding measured weight on the LCD simultaneously. The readings of the weighing system produced were compared to that of a standard weighing system. The result showed a mean deviation of 1.44Kg between the readings of the modified scale and the analogue scale which served as the control. A simple product moment correlation coefficient was used to compare the two readings and the result obtained showed that there was a near perfect correlation of 0.9998 between the readings taken from both scales.

[10] developed an automatic digital weighing system that operated with solar energy. The advantages of this system are the implementation of efficient energy, miniaturized parts, great accuracy and efficiency, low cost. The system operates on AC and DC supply. This system developed measures weights ranging from 0-40kg.

[11] developed a hybrid digital weighing scale which is energy efficient and can be used for weight measurements. The system detects minute weights placed over it, accurately reads and measures it kilograms and displays it on the LCD module. The system developed converted pressure into appropriate voltage levels. The voltage level was filtered and converted into digital data in the microcontroller which was displayed on a LCD.

3. MATERIALS AND METHODS

The materials used in the development of this design are listed as follows:

- An arduino Uno microcontroller
- A 40kg Load cell
- An HX711 Load cell Amplifier Module
- A 16x2 LCD

The architecture and programme flowchart of the system is shown in figure 1 and figure 2 below.

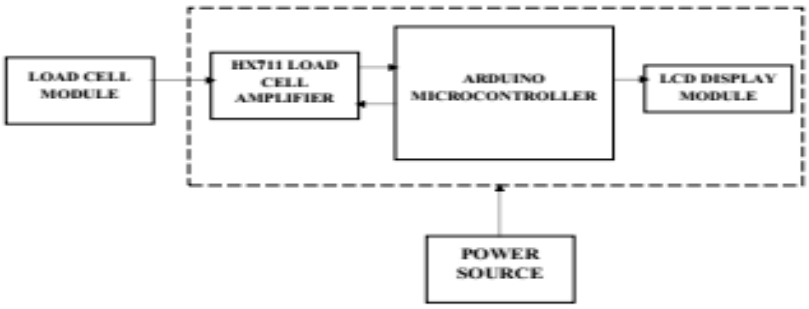

Fig. 1: System Architecture

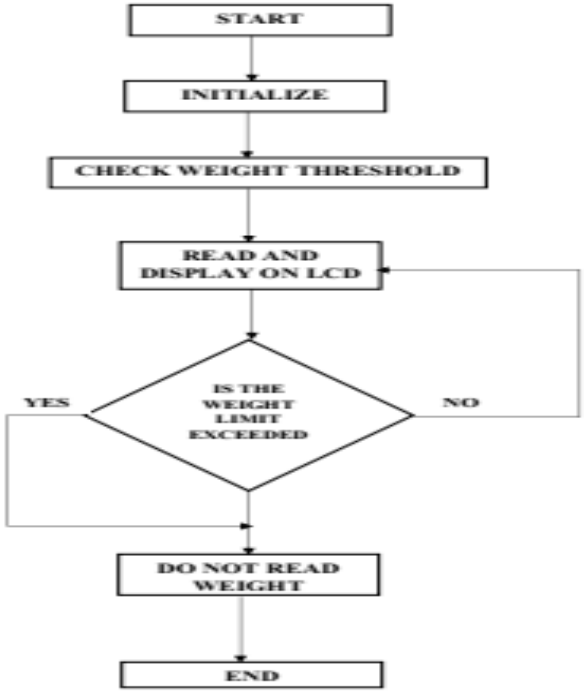

Fig. 2: System flowchart for the developed system

4. SYSTEM ANALYSIS

A cheap electronic Digital weighing indicator for digital measurement was developed which was designed for a maximum weight of 40kg. The components acquired for the development of this project are an arduino uno microcontroller, a 40kg load cell, an Hx711 load cell amplifier module and a 16x2 LCD Module. Figure 3 shows the circuit diagram of the developed system.

I. Arduino uno

The arduino uno was used control centre for the project. The arduino was programmed in Arduino c++. All activities for the developed system are carried out in the arduino uno. These activities include the activities carried out by the load cell, Hx711 load cell amplifier and the display on the 16x2 LCD.

II. Load cell

The load cell which is also known as a transducer converts mechanical energy (weight) to an electrical output. The magnitude of the electrical output is directly proportion to applied force. The strain guage in the Load cells deforms when pressure is applied on it. Strain gauge generates electrical signal during deformation because its effective resistance changes during deformation. The load cell weighs up to 40kg of load. The load cell is shown in figure 4 below.

Mathematical analysis for the load cell

Rated capacity----------40kg
Rated output----------1mv/v
Excitation voltage----------5v
(Load) 40kg→5mv (output voltage)

If 40kg (40000g)→5mv
1g→X
40,000X→5
$X \rightarrow \frac{5}{40,000} = 0.000125$
$X \rightarrow 125 * 10^{-4}$
X→125µm
1g→125µm

Maximum weight→40kg

Therefore Minimum Volt for 1g→125µm
Minimum Volt for 40kg→ $5mv$

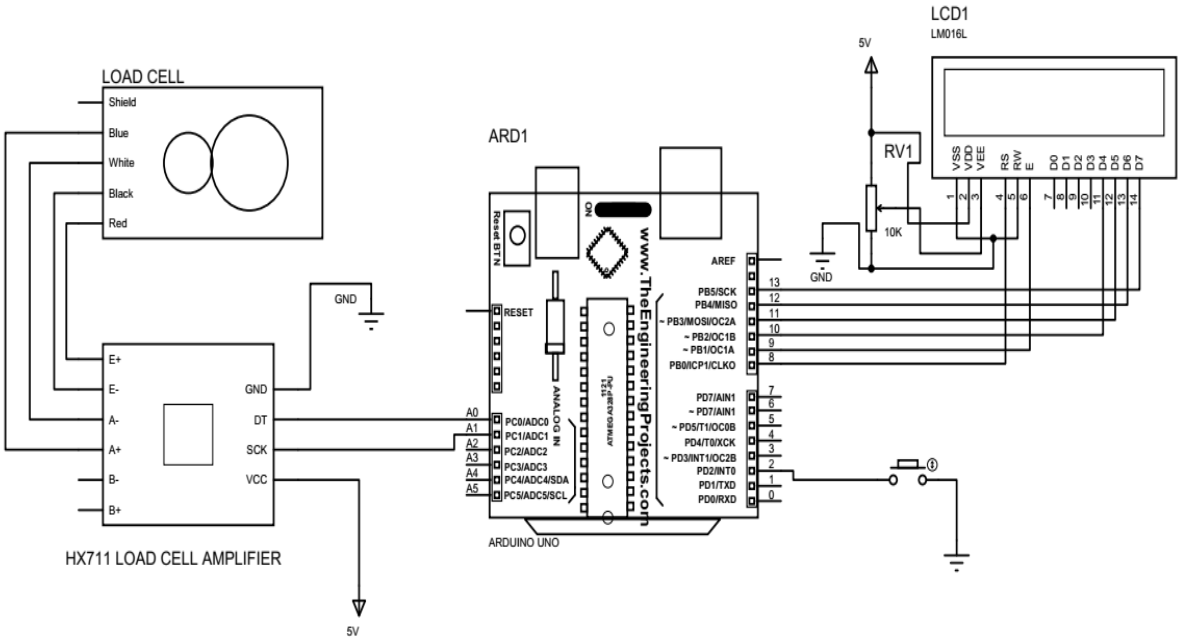

Fig. 3: Circuit diagram for the developed system

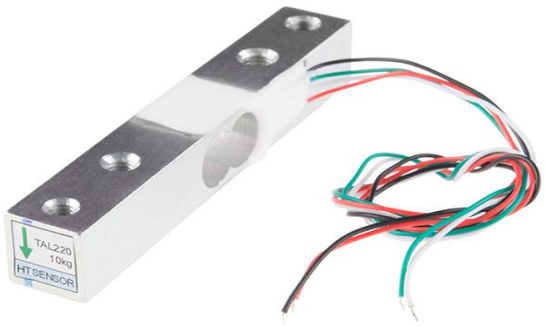

Fig. 4: Diagram for the load cell

III. Hx711 Load Cell amplifier Module

Hx711 Load cell amplifier module is a 24 high precision analog to digital converter which amplifies low electric output from the load cells, amplifies and converts the low electric output of the load cell gotten from the mechanical energy (weight) and converts it to a digital form. The digital form is transmitted into the arduino uno to generate the weight. When the load cell amplifier is connected to the microcontroller, changes in the resistance of the load cell will be read by the microcontroller with some calibrations. This causes very accurate weight measurements. The diagram for the load cell amplifier module used is shown in figure 5 below.

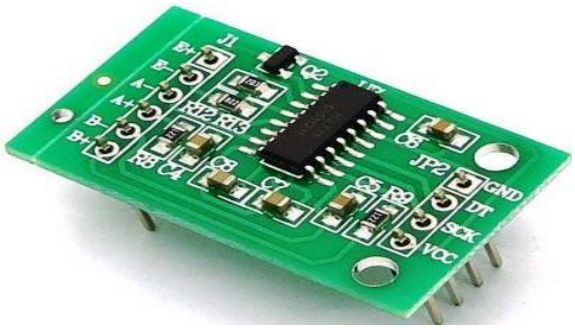

Fig. 5: Diagram of the Hx711 Load Cell amplifier Module

IV. LCD DISPLAY

The LCD display is an electronic display module used to display the output of the scale result of the developed system.

5. RESULT

A prototype for the Electronic Weighing Indicator was physically constructed. All parts worked as designed. The components of the working system are the Arduino Uno, a 40kg Load cell, a HX711 Load cell Amplifier Module and a 16x2 LCD module. The diagram of the constructed working prototype is shown in figure 6 and 7 below.

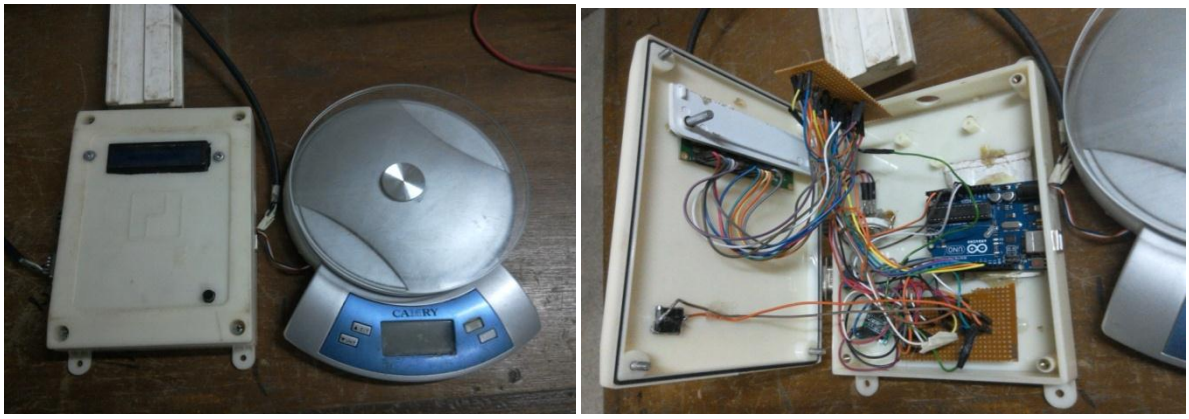

Fig.6: full prototype of the system

6 CONCLUSION

An Electronic Weighing Indicator system was developed for digital measurement and the functions of the components were explained in the course of this paper. This system was built to read weight measurement digital form. The system developed consisted of a 40kg load cell which read mechanical energy (weight) between 0 to 40kg. The load cell amplifier module reads the output from the load cell and converts the data from analog to digital form which is then fed to the microcontroller. The microcontroller processes the data, apart from coordinating the activities of the entire system. The processed data is the sent from the microcontroller to the LCD module which is displayed for the user to read.

REFERENCES

1. Nikita Mahajan, Neha Bhosale, Mamta Khatape "Study of weight measurement system using PIC microcontroller," International Journal of Advanced Scientific and Technical Research. Issue 4 volume 4 July-August 2014 pp. 171-183
2. Dr. Pradeep B. Dahikar, Mr. Kamlesh S. Patle "Design of an Embedded platform for Digital weighing system to enhance measuring capabilities," International Journal of Innovative Research in Computer and Communication engineering. Volume 1 Issue 8 october 2013 pp. 1881-1887
3. Kimani Peter Ng'ang'a "Microcontroller Based weighing Machine," final year project, Electrical and Electronic Engineering of the University of Nairobi. 22 may 2014
4. Munyao kitavi "Design and fabrication of a microcontroller based electronic weighing machine in high mass regime," m.sc thesis, Kenyatta University, August 2009
5. S.A Fagbemi, M. Momoh, I.G Saidu, D. O. Akpootu, S.B. Sharafa and M.J. Abdulsalami "Digitalisation of an Analogue weighing scale using Microcontroller." IOSR- Journal of environmental science, Toxicology and Food Technology. Volume 8, Issue 2. March-April 2014. Pp. 126-134
6. Victor O. Matthews, Etinosa Noma-Osaghae, Uzairue Stanley Idiake "An Analytics Enabled wireless Anti-Intruder Monitoring and Alarm System," International Journal of Scientific Research in Science, Engineering and Technology. Volume 4 issue 9, July-August 2018 pp.5-11
7. Victor O. Matthews, Uzairue Stanley Idiake, Etinosa Noma-Osague, Morgan Kubiat Enefiok, Praise Jude Ogukah "International Journal of Innovative Science and Research Technology," volume 3 issue 6 june 2018
8. Awodeyi Afolabi, Samuel Isaac Adekunle, Akindele Ayoola E., Matthews Victor Olugbemiga, "Design and Construction of a Microcontroller Based Automated Intelligent Street Lighting System," International Journal of Scientific and Engineering Research. Volume 9 issue 5, may 2018 pp. 2302-2308
9. Awodeyi Afolabi I., Obomighie Moses, Makinde Opeyemi S., Ben-Obaje Abraham A., Abayomi-Zannu Temmidayo P. "Design and Construction of a Panic Button Alarm System for Security Emergencies," International Journal of Engineering and Techniques. Volume 4, Issue 3. May-June 2018
10. Sandip N. Rikame, Pradip W. Kulkarmi. "Digital Electronic weighing machine operate on solar energy with emergency LED light," International Journal of Emerging Technology and Advanced Engineering. Volume 4 Issue 7 July 2014
11. Chukwuedozie N. Ezema, Albert C. Agulanma, Okechi Onuoha, Helen U. Nonyelu, Nwanyinnaya Nwogu "International Journal of Engineering Research and Reviews," Volume 4, Issue 1 January-March 2016. Pp. 74-81