IMPLEMENTATION OF MATRIX KEYBOARD IN DIGITAL X-RAY MACHINE BY USING EMBEDDED SYSTEM DESIGN

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Abstract - This paper describe the development and implementation of rotary switches converted into digital switch using embedded system design being used in x-ray machine for production facilities. Digital techniques are discrete techniques and they have been applied to automatic services, as this technology is economically viable.

The accuracy of voltage and current should be as required for x-ray of different parts of body. By using analog to digital converter, voltage and current can be increased or decreased in steps to ensure proper x-ray of the body part with high efficiency.

Keywords - Complementary metal–oxide–semi conductor (CMOS), metal–oxide–semiconductor field-effect transistor (MOSFET), Transistor–Transistor Logic (TTL), KiloVoltAmpere (KVA), American Standard Code for Information Interchange (ASCII).

INTRODUCTION

There are numerous changes in technology and electronics play an important role in innovations and discoveries. Industrial designs must satisfy time to market requirements. During the design phase the designer must be able to evaluate the overall system performance. The control panel of x-ray machine which was consisting of rotary switches converted fully to digital using embedded system design.

The development of the X-ray art reveals that during most of the period the principal advances were made in the field of medicine, with applications in two broad categories, namely, diagnosis and therapy. However, at the present time an important proportion of the X-ray apparatus in existence is devoted to industrial applications. In comparing industrial and medical applications of X rays, it becomes apparent that by far the greater proportion of industrial applications are diagnostic in nature; that is, the discovery of certain information about the internal structure of the material being irradiated is the object of the operation. In many cases, differential absorption, detected by film, fluorescent screen, or ionization device, is utilized to reveal the desired information just as in the case of medical diagnosis. In other cases, the diffraction of the rays into definite patterns, recorded by similar means, provides the information.

X-ray illumination, direction and with controllable, variable depth from the object surface, the main aim of X-ray machine is to find the defects, fractures or broken bones of human body. The X-ray machine's rays are passed through the concerned part of human body. These rays penetrate through the muscles and through the bones. Due to this property of X -ray an image is created and a full view of fractured bone is detected. These rays are harmful to human body; so basic parameters to be considered are

1. Power (KVA rating) of X -rays and
2. Time duration of X -rays existing on human body.

FACTORS AFFECTING X-RAY OUTPUT

The principal factors which affect the intensity of the X-ray beam issuing from an X-ray tube are:

(1) Target material;
(2) Anode voltage;
(3) Anode current;
(4) Absorption by intervening material; and
(5) Distance from focal spot to point of utilization.

TYPES OF SWITCHES

A. Rotary Switch

A rotary switch is a type of switch that is used on devices which have two or more different states or modes of operation, such as a three-speed fan or a CB radio with multiple frequencies of reception or channels.

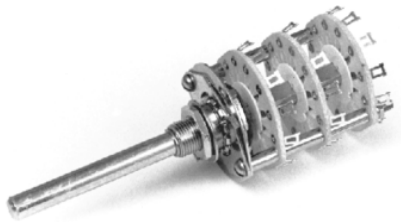

Fig.1. Rotary Switch

A rotary switch[1], consists of a spindle or rotor that has a contact arm or spoke which projects from its surface like a cam. It has an array of terminals, arranged in a circle around the rotor, each of which serves as a contact for the spoke through which any one of a number of different electrical circuits can be connected to the rotor. The switch is layered to allow the use of multiple poles, each layer is equivalent to one pole. Usually such a switch has a detent mechanism so it clicks from one active position to another rather than stalls in an intermediate position.

Rotary switches were used as channel selectors, range selectors on electrical metering equipment, as band selectors on multi-band radios, etc.

B. Analog Switch

The analogue (or analog) switch[2], also called the bilateral switch, is an electronic component that behaves in a similar way to a relay, but has no moving parts. The switching element is normally a MOSFET (Metal Oxide Semiconductor Field Effect Transistor), which is a type of transistor. The control input to the switch is a standard CMOS (Complementary Metal Oxide Semiconductor) or TTL (Transistor-Transistor Logic) logic input, which is shifted by internal circuitry to a suitable voltage for switching the MOSFET[3]. The result is that a logic 0 on the control input causes the MOSFET to have a high resistance, so that the switch is off, and a logic 1 on the input causes the MOSFET to have a low resistance, so that the switch is on. Analogue switches are usually manufactured as integrated circuits in packages containing multiple switches (typically two, four or eight).

Fig.2. shows a MOS (Metal Oxide Semiconductor) analog switch, M3 is a controlled transmission gate, M1 and current source form source follower. Input signal is connected to one side of M3, the other side of M3 is connected to the gate of M1, control signal Vc is connected to the gate cjf M3. When Vc is high, input signal passes M3 and reaches the gate of M1, output signal is achieved from the source of M1. Because of high input impedance of M1, the plug-in consumption is low, isolation between input signal and output signal is also realized.

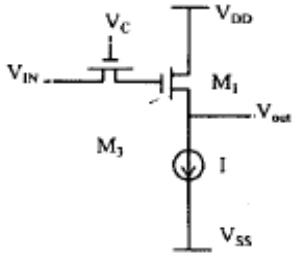

Fig.2. MOS analog switch

The resolution of switch depends on source follower. Unlike a relay, however, the analogue switch does not provide electrical isolation between the analogue signal and the control signal. This means that it should not be used in high-voltage circuits where such isolation is desired. Also, since there is only a low current path between the input and output, the maximum current allowed through the switch may be smaller than that in a typical relay. There are also some constraints on the polarity and range of voltages of the signal being switched.

C. Matrix Keyboard

To use different keyboards and keypads for different application needs certain data information or codes. In the proposed design of the keyboard matrix the codes are specially designed in ASCII and in return their HEX codes are given to the controller.

Fig.3. shows a conventional keyboard matrix scanning structure. The scanning lines of the keyboard which respectively connects to an X-port and a Y-port are typically arranged into a matrix, such as a matrix consisting of n rows and m columns of scanning lines. Each cross point corresponds to a position that one key is located and thus there are totally n x m keys. In the proposed designed it's a 5x7 matrix key board.

One scanning line of each key is electrically connected to the Y-port which serves as a scanning signal output port and has totally n lines. The other scanning line of each key is connected to X-port which serves as a scanning signal input port and has totally m lines. When a key is pressed, an electric conduction is constructed between two corresponding lines which cross at its corresponding position, and thus a scanning signal output from a corresponding line of Y-port will be sent to a line of X-port, thereby the position of the key being pressed is able to be detected. Depending upon the logic levels of both X-port and Y-port the codes have been calculated. Initially both are held at high logic level.

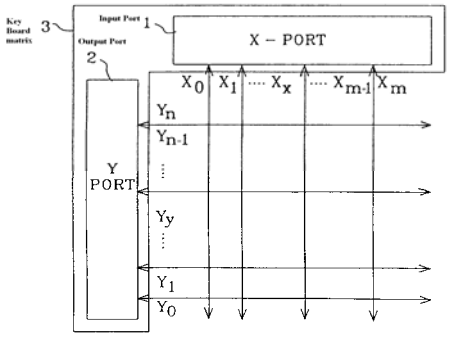

Fig.3.Matrix Keyboard structure

BASIC STRUCTURE

The basic structure of rotary switch control of X-ray Machine is shown in Fig. 4. The insufficient current selection of this control, a new enhanced digital system keyboard is shown in Fig. 5, where it automatically selects the current from the range of 25mA to 100mA where where it has a selection of 25, 50, 100mA for radiography for specified part.

It hunts down automatically to the necessary current and power rating and gives the clear image on the computer and then the X-ray is shooted. The image of X-ray is of enhanced quality

Fig.4.Rotary switch control panel of X-ray Machine

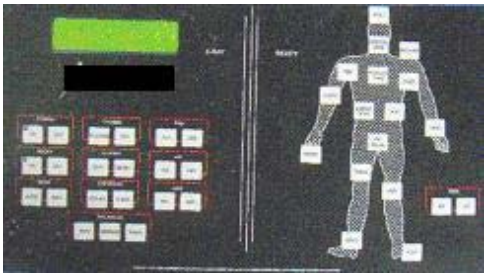

Fig.5.Digital control panel of X-ray Machine

The keyboard operates in two modes:

a. Manual

b. Automatic

a. Manual Mode Flow

The first few steps to be used as shown in automode. After selecting all parameters, KVP is set according to body part, mA is set and MAS is set i.e time for exposure.

For example, if mA is set to 25mA, KVP is set to 40 and time is for 2 sec., then so product of 25 mA X 2sec = 50 as this value is being used by MAS for exposure which is better for X-ray.

Then for firing, pressing the stand by key first then for 0.8 sec it is on stand by or more after that X-ray key is fired. Setting of KVP is actually setting values from Variac, the output of variac is fed to X-ray tube and to Port P1 and P2 which in return given to MAS, mA is given to the filament to F1 and F2.

b. Auto mode Flow

X-ray machine is put on. First auotmode is selected by default, if wanted to select manual mode then switch to manual key and press it to start the manual mode.

To select view, whether AP view or Lateral view, press respective switch, then select the body type like thin, medium or thick from the digital control of key board.

Next select which body part to be X-ray. All these switches are operated by operator and then automatically proper values of KVP are done and x-ray is shooted

The block diagram in Fig. 6 shows two micro-controller working specifically with keyboard through which input can be changed and to shoot the X-ray of required body part.

The design of Digital X-ray Machine can be divided in to three main parts:

1. Power control unit
2. Controller Card
3. Keyboard matrix

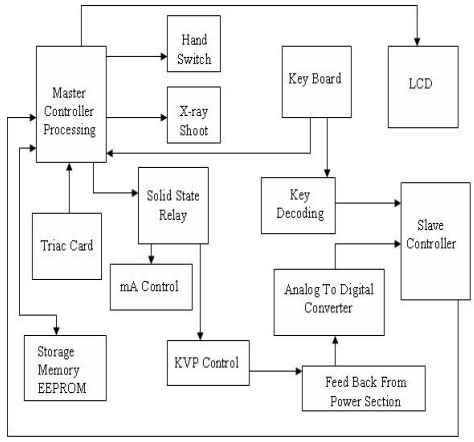

Fig.6.Block diagram of Digital X-ray Machine

Fig. 7 shows how the controls are automated as soon as power is on. There is no need to adjust voltage and current ratings manually as when the system is power on, the system scans the full body and comes to a centre point and by pressing the digital key of that particular part, voltage and current ratings are selected. The shooting of X-ray is completed and a optimized quality of X-ray is generated.

The voltage and current is inputted through keyboard and given to dedicated microcontroller, in return the microcontroller decodes the keys and translates the information to ASCII format. This information is fed to the master controller and it processes to the relay to hand shoot and X-ray is shooted. The machine is so compact and mobile that one not has to move the patient from one place to other to take X-ray in Radiography section.

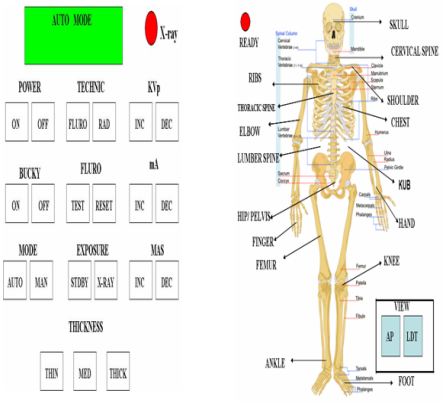

Fig.7.Body scan after power on. Display shows voltage and current ratings of digital control panel

HARDWARE DESIGN

Fig.8.300 volt span variac / 20 amp current rating, sweep 360 degree and motorosed. 230 volt servo motor

Fig.9.Power supply card

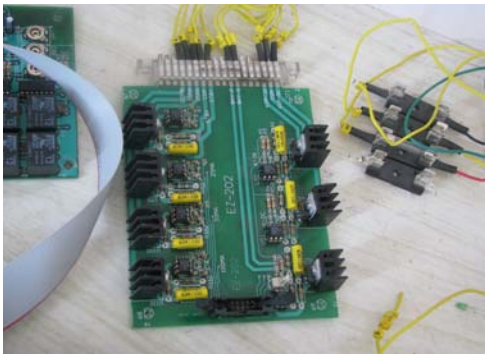

Fig.10.Triac card

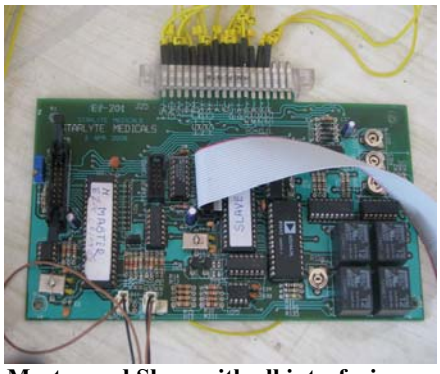

Fig.11.Master and Slave with all interfacing peripherals

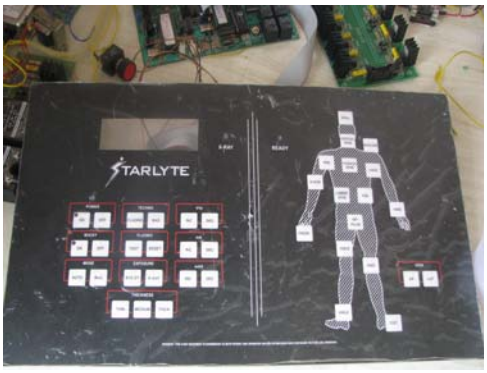

Fig.12.Digital matrix keyboard

EXPERIMENTAL RESULTS

The table no.1 shows the values of various body parts of human being (normal body) taken for quality X-ray.

Table -1
Ratings of Different Body Parts for a Normal Body type

Body parts	Current in mA	Exposure time to shoot X-ray (MAS) (sec)	KVP
Skull	50	62.5	65
Cervical spine	50	20	60
Shoulder	50	20	60
Ribs	50	50	65
Thoracic	50	62.5	65
Chest	50	20	55
Elbow	50	10	48
Lumber	50	75	76
Kub	50	75	80
Hand	50	6.5	45
Finger	50	3	43
Hip	50	75	75
Femur	50	20	60
Knee	50	20	53
Ankle	50	15	50
Foot	50	5	45

The figure 13, 14, 15 shows the amount of voltage and current ratings passed to shoot X-ray of the specific part of the body.

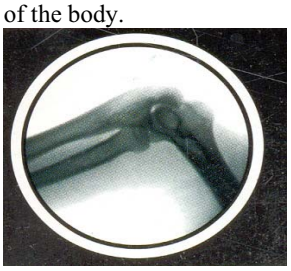

Fig.13.X-ray of leg part with tibia and fibula when the voltage and current are not according to the ratings required for proper intensity taken using rotary switch.

Fig.14.X-ray of leg part with tibia and fibula with all specified ratings taken using digital control

Fig.15.X-ray of hand wrist with carpals, metacarpals and phalanges taken using digital control

CONCLUSION

This paper has discussed some aspects of rotary switch replaced by matrix keyboard digital. Design techniques for digital are essential for high performance to shoot X-ray. A top down design methodology, based on digital to X-ray radiation analysis from early stages, improves the robustness and reduces the risk of failures in shooting X-ray of proper intensity of a specific body part. It is seen that for various types of bodies the mode of operation is different and the ratings are also different, to get a quality X-ray.

REFERENCES

[1] Joel. A. Jr., "Digital Switching--How It Has Developed," Communications, IEEE Transactions on [legacy, pre - 1988] Volume 27, Issue 7, Jul 1979 Page(s):948 – 959.

[2] Wu Ge, Shi Yin, "A one-way MOS analog switch," Solid-State and Integrated Circuit Technology, 1998. Proceedings. 1998 5th International Conference on, 21-23 Oct. 1998 Page(s):413 – 415.

[3] Ruegg, H.W., "An integrated FET analog switch," Proceedings of the IEEE Volume 52, Issue 12, Dec. 1964 Page(s):1572 – 1575.

[4] Encyclopedia, "X- ray," "X-ray Machine," "Rotary switch," "Analog switch," en.wikipedia.org.

BIOGRAPHY

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