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Synchronous Radiation Exposure and X-Ray Room Access Control: A Proposed Novel Approach to Radiation Protection of Staff, Patients and the Public in Diagnostic Radiography

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Abstract

This aim of this article is to propose an automatic door locking system for the x-ray room entrance door which is designed to enhance the radiation protection of staff, patients, and the public. The automatic door locking system is designed to restrict unauthorized individuals from gaining access to the x-ray room during x-ray exposure. The automatic door locking system for the x-ray room entrance, which is synchronized with the x-ray exposure mechanism, was conceived. The system was then designed and built with the aid of circuit diagrams. The performance testing and evaluations carried out before and after coupling of the components of the system showed the system could be adopted in the design, manufacture and installation of future x-ray equipment in diagnostic and therapy rooms.

Keywords: Automatic door locking system; Radiation protection; X-ray room access control

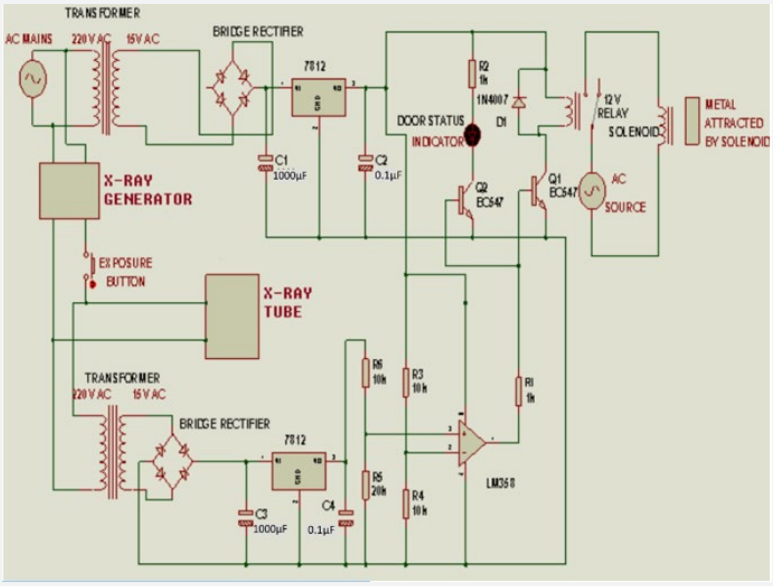

Figure 1: The complete circuit diagram of the system.

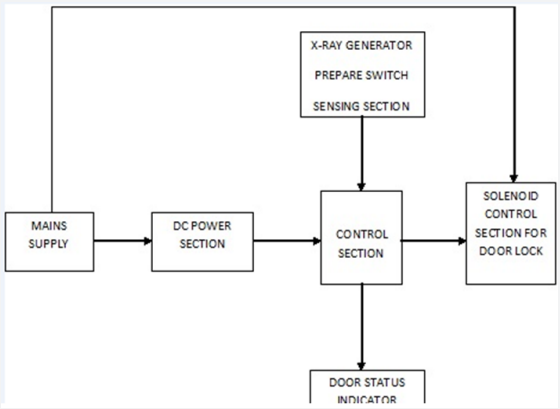

Figure 2: A block diagram the automatic door locking system.

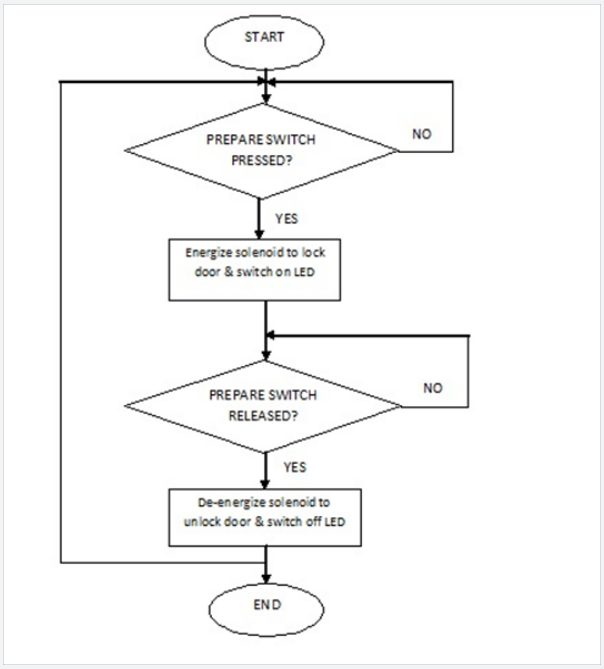

Figure 3: Operational flow cahrt of the automatic door locking system.

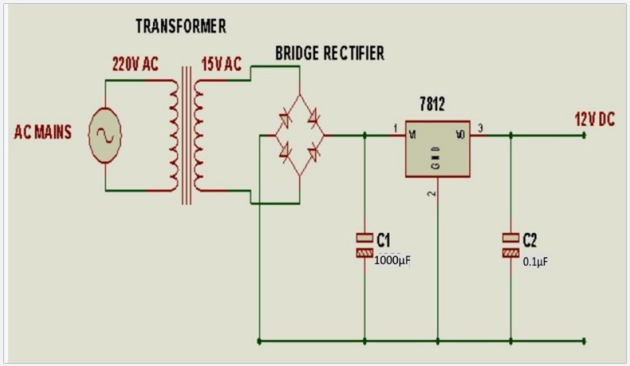

Figure 4: The pover input section of the automatic door locking system.

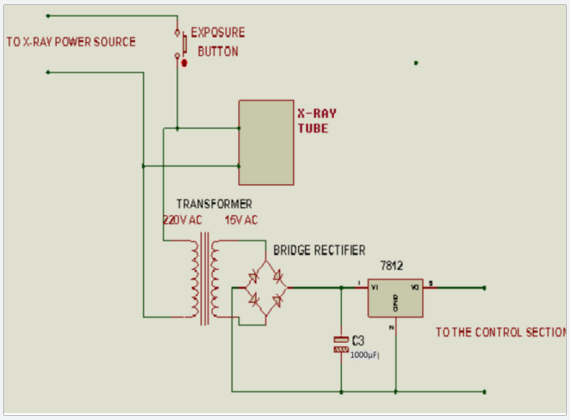

Figure 5: The sensing circuitry for the automatic locking system.

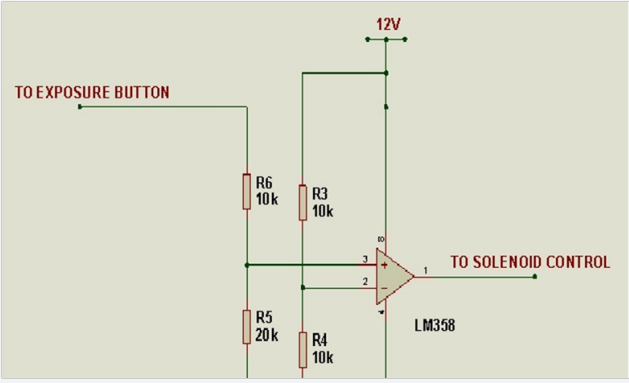

Figure 6: The control circuitry for the automatic locking system

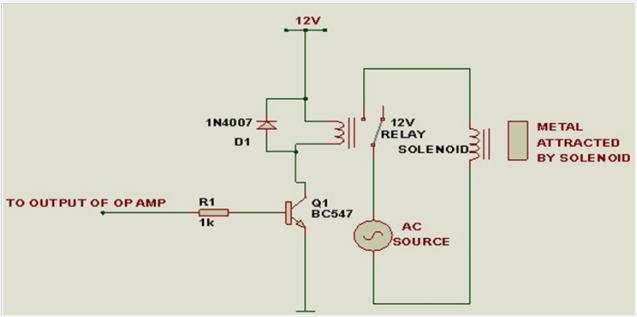

Figure 7: The magnetic control circuitry for the automatic locking system.

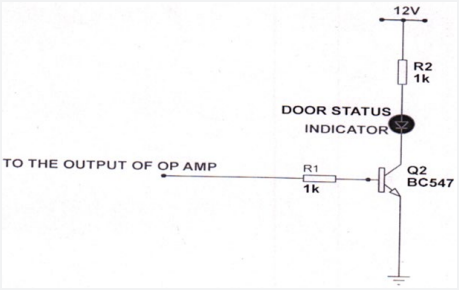

Figure 8: Circuit diagram of the door status indicator.

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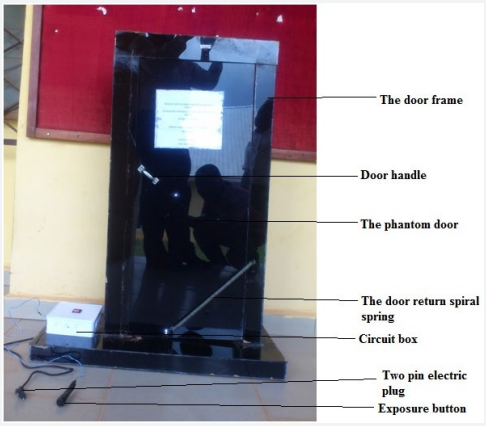

Figure 9: An automatic locking system built in to Perspex phantom door.

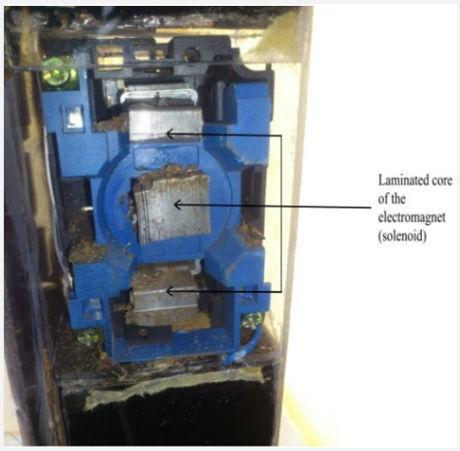

Figure 10: The electromagnet embedded within the door frame.

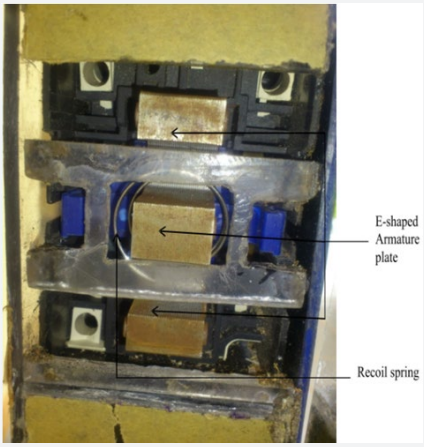

Figure 11: The recoil armature plate embedded within the door.

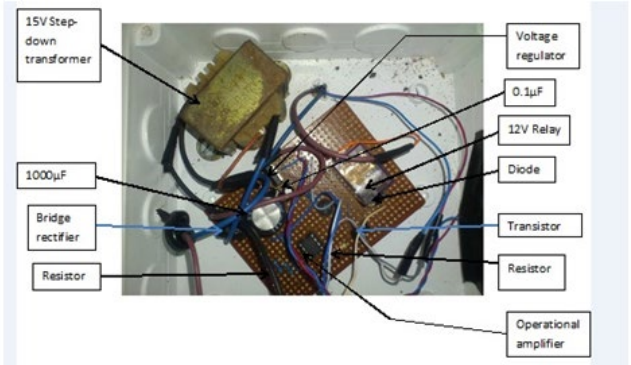

Figure 12: The recoil armature plate embedded within the door.

Figure 13: Showing the armature plate and electromagnet when the door is ajar.

Table 1: The results of magnetic strength test at 220V.

Without the Return Spring		With the Return Spring	
Distance (cm)	Contact	Distance (cm)	Contact
5.0	No contact established	5.0	No contact established
4.5	No contact established	4.5	No contact established
3.5	Magnetic field felt	3.5	Slight magnetic field felt
3.0	Contact firmly established	3.0	Not enough magnetic field to establish a contact
		2.5	Contact firmly established

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Table 2: Variation of magnet's ability to make contact with the armature plate with the applied voltage.

Voltage (V)	Maximum Distance at which Contact was Established (cm)
150	No contact
160	0.00
170	0.3
180	0.5
190	1.0
200	1.0
210	1.5
220	2.0

Table 3: Result of the test of the ability of the door spring to close the door.

Distance (cm)	Closure
22	Closed but not tight
25	Fairly tight
28.5	Firmly tight

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