RESTRICTED ACCESS CONTROL FOR DOORS AND GATE SECURITY USING GSM WIRELESS NETWORK

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ABSTRACT
This paper is to view the possibility available to us through the Global System for Mobile Communication (GSM) wireless network system, which can be applied to door/gate access security and control in offices and homes. The opening and closing of door can be very tasking being the reason why public places like shops and hotels put an automatic system to open and close doors for customers while others employ bell boys for this purpose. There is the possibility of extending this to homes and offices by using wireless GSM network to perform this task such that one can activate the door to open while he is still approaching the door using one's hand set. Also access can be granted to only authorized persons who have been given the access code thereby creating access security. There is the possibility of applying it for house gate and eliminate the need for gate man in the compound.

Key words: GSM, Hand set, Access, Security, Control, Door/gate

INTRODUCTION

This paper has to do with a demonstration that Restricted Access Control for Doors and Gate Security using GSM wireless network is achievable. The restricted access control system consists of; the Uninterrupted Power source or supply unit, the Input device and sensor unit, the Controller unit including Timer relay and GSM (Global System for Mobile Communication) module, and the Actuator unit. Hence, the Control system can be divided into those four (4) Units.

The system grants entry through the door/gate by the use of GSM hand set or entry switch (optional), and allows exit by GSM hand set or infrared detectors. The entry switch (where it is included in the design) and the infrared detectors can be programmed to deactivate at any period with a 24-hour timer system so that entry and exit becomes only by the GSM hand set, and how long the door/gate remains open before closing automatically can be controlled with a 60-second delay timer (Drucker, 2007). The restricted access controller runs and is available all day for 24 hours always without power interruption even in the absence of electric power from PHCN (Power Holding Company of Nigeria). This can be achieved by the use of uninterrupted power system such as an inverter with battery . The battery supplies DC (direct current) power while the inverter stores charges in the battery when PHCN power is available and inverts the dc power supply of the battery to an AC power supply thereby maintaining power always.

The low power consumption of restricted access control system makes it possible for the battery DC power to be able to last as long as 48 hours uninterrupted, even more depending on the usage frequency. It is envisaged that within this time PHCN power would have been restored or the standby power generator set would have been put on (Kusko, 1998).

The design can include an isolation switch to allow the door/gate to remain in an opened position as long as the need be if such need arises, say for maintenance work or any work activity for safety.

LITERATURE/THEORETICAL ANALYSIS
In electronics, a switch is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another. The most familiar form of switch is a manually operated electrome-

chanical device with one or more sets of electrical contacts. Each set of contacts can be in one of two states: either 'closed' meaning the contacts are touching and electricity can flow between them, or 'open', meaning the contacts are separated and not conducting. (Mufflin 1979, Sedha and Smith 2005)

A switch may be directly manipulated by a human as a control signal to a system, such as a computer keyboard button, or to control power flow in a circuit, such as a light switch. (Mufflin, 1979 and Fraser 2006) Automatically-operated switches can be used to control the motions of machines, for example, to indicate that a garage door has reached its full open position or that a machine tool is in a position to accept another work piece. Switches may be operated by process variables such as pressure, temperature, flow, current, voltage, and force, acting as sensors in a process and used to automatically control a system. For example, a thermostat is a temperature-operated switch used to control a heating process. A switch that is operated by another electrical circuit is called a relay (Kusko 1989 and Simpson 2002).

A motion detector like infrared detector is a device that contains a physical mechanism or electronic sensor that quantifies motion that can be either integrated with or connected to other devices that alert the user of the presence of a moving object within the field of view. They form a vital component of comprehensive security and restriction systems, for both homes and businesses. An electronic motion detector contains a motion sensor that transforms the detection of motion into an electric signal. This electric signal can be used to operate a switch as a relay.

GSM is a global system for mobile communication. It is an international digital Cellular Telecommunication. The GSM standard was released by ETSI (European Standard Telecommunication Standard) back in 1989. The first commercial services were launched in 1991 and after its early introduction in Europe; the standard went global in 1992. Since then, GSM has become the most widely adopted and fastest-growing digital cellular standard, and it is positioned to become the world's dominant cellular standard. Today's second-generation GSM networks deliver high quality and secure mobile voice and data services (such as SMS/ Text Messaging) with full roaming capabilities across the world (Rappaport, 1996).

In the late 2000s-early 2010s, a number of smart phone and portable media player platforms were provided with installable software applications which allow for the remote controlling of media centers and media players on home theater PCs and general-purpose personal computers over wi-Fi, such as iTunes Remote on iPhone OS. This is achieved by transforming the input into electric signal to perform such operation. This electric signal can also be used to operate a switch as a relay using the adaptable software and module.

Automatic control is about switches logically connected to activate appropriate signal for the actuator mechanism to perform specified functions. Therefore, putting these systems together and logically interconnected, electric signal is generated as input to the actuating mechanism which performs the opening and closing of the door/gate.

EXPERIMENTAL PROCEDURE/DESIGN

Uninterrupted Power supply:

The uninterrupted power system setup is as shown below;

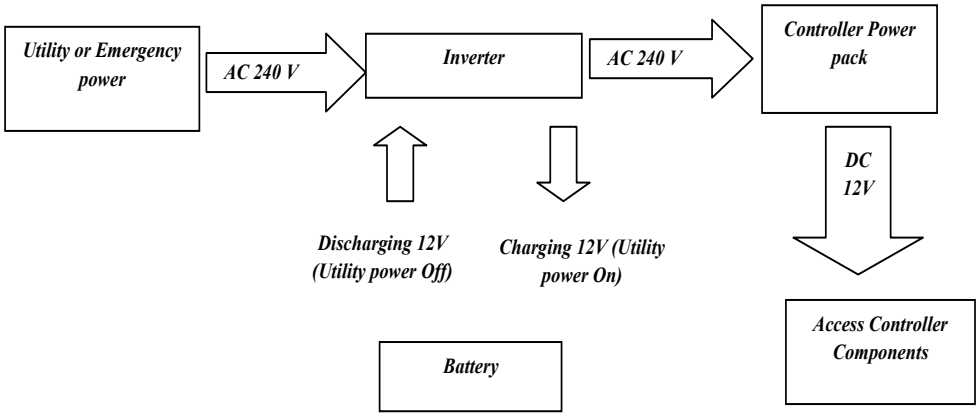


Fig 1: Uninterrupted Power Flow Diagram

The inverter and battery are connected such that when there is utility power (PHCN or emergency power) the inverter transmits power (AC 240V) directly to the control system and also store charge in the battery for use when utility power is out. The control system also has a power pack which converts the AC power to DC for the restricted access control system components which use DC power.

Input Devices/Sensor Unit

These are the command initiators as the name implies the media for imputing the necessary command to the controller. There are five of them:

- Entry switch outside the door (optional),
- A pair of infrared detectors in side, located at about 5 meters before the exit of the door/gate (position is based on space and location),
- Limit switches located close to the actuator unit,
- 24-hour Timer and 60-seconds timer, and
- Automatic GSM control module.

This unit was designed such that the entry switch and the pair of infrared detectors initiate the command to open the door alongside the GSM control module through the hand set. The entry switch does so when it is pressed by the person who wants to gain entry, while the pair of infrared detectors does not require the user to take any action on it but to just walk by towards the door/gate when exiting. The device detects that somebody is moving towards the exit, when the continuity signal between the pair is broken or tripped, and initiates the command for the door to open. The entry switch is optional as it can be excluded so that all visitors have to be identified and granted access by the GSM hand set which becomes the only input device for entry.

The limit switches, in the design, as the name implies initiates the command for the actuator to stop the opening or closing of the door by sensing that the door has been fully opened or fully closed. This was achieved by locating the switches at positions that will indicate fully open or close position with a mechanism that will actuate the switches when either of these positions is attained by the door. The fully open limit switch also initiates a close command for the door/gate to be closed after 5 seconds (adjustable), by activating the 60-seconds timer relay in the controller.

The 24-hour timer is the component that gives the controller information regarding the time of the day. It performs as the restricted access

controller 'wrist watch', by which the controller knows when the restricted access time as programmed (say night time), has been reached and gives the command to deactivate the entry switch signal and the infrared detector signal and prevent anyone without the automatic GSM control module access code. In other words, the only input device that is active during the restricted access period is the automatic GSM control module and the timers. The timer remains active so that the controller continues to keep to time and issue open access command when the period of restriction is over.

The automatic GSM control module input device is achieved through the wireless GSM network and the user's hand set. The GSM module has a code which when dialed in the phone of the user with any GSM network, the signal is received by the module through the wireless network and initiates the command for the controller to open the door. This is not proximity dependent but GSM network provider dependent, implying that wherever the user is with his or her GSM hand set and available network at his or her location and at the facility location the door can be opened with the appropriate code.

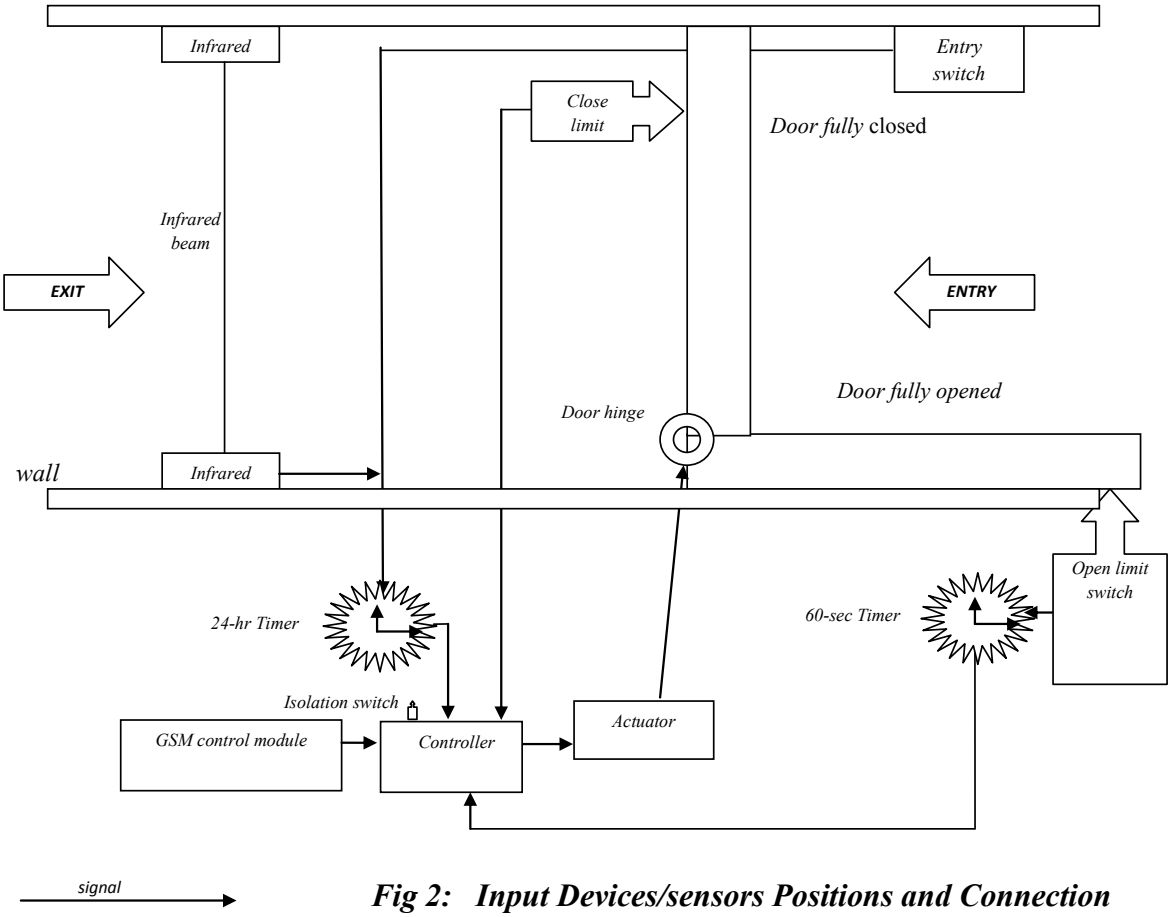


Fig 2: Input Devices/sensors Positions and Connection

Actuator Unit

The design adapted and actuator unit that allows the automatic restricted access control to achieve fully open position of the door at 90 degrees rotation angle as shown in the diagram above.

Actuator mechanism

The actuator mechanism consists of two sets of gears, namely

- A pair of spur gears, and
- Worm and wheel gears.

The actuating motor carries the worm and wheel gears while the actuating mechanism is of spur gear system. The worm and wheel gearing was used to change the motor axis of rotation to another rotation axis perpendicular to it. The smaller diameter spur gear was made of the same center and axis with the wheel gear of the motor and it drives the larger diameter spur gear. The design can attach

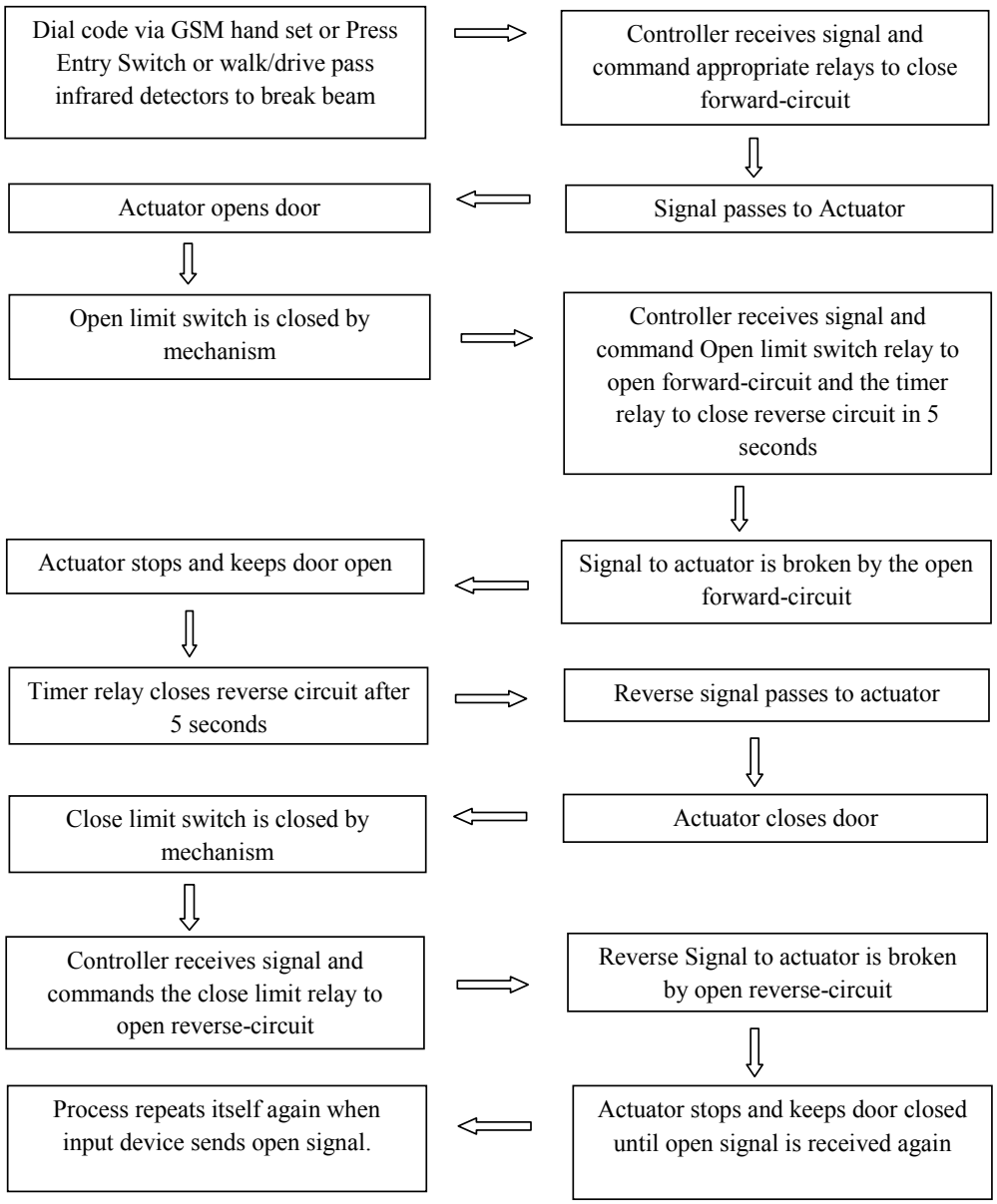
a slot pin and bearing to drive the door if the center of pivot of door/gate swing is different with that of the drive mechanism (larger spur gear). This would not be necessary if the centers are the same.

Controller Unit

The controller by design receives all information initiated by the input devices/sensors, process it and issue the command to the actuator unit to perform the initiated command. It consists of relays connected together in a logical sense such that every input is rightly downloaded and the right marshal (relay) is activated for the actuator to perform the required output function of the input command.

RESULTS AND DISCUSSION

Control flow Process



The process is such that entry by visitors may be granted through the entry switch and the 24 -hour timer is programmed to deactivate it when visitors are not wanted to gain thorough access in the evening/night time and when nobody is at home or the office. Leaving the premises after gaining access is open through the infrared detector which can also be programmed to deactivate in the evening/night and when the owner of the premises is not available, so that one does not find one's way through the fence and open the gate by walk-

ing pass the infrared detectors from within.

Also for greater security, the design can incorporate an actuating mechanism to bolt the door/gate when it closes and to unbolt before opening. This can be programmed in the controller, so that even a hard push will not open the door/gate.

CONCLUSION

This paper demonstrates the use of GSM technology to control the operation of the opening and closing of doors and gates eliminating manual control and hence the use of a gateman. It also shoes that security network would be improve with the restricted access control that is programmed to function as the owner wishes. The design can be made to incorporate an alarm alert when an undue force is applied on the door or gate or when unnecessary motion at odd hours is detected around the premises.

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