PROXIMITY INTRUDER SECURITY SYSTEM: A TECHNOLOGICAL AND SCIENTIFIC INNOVATION FOR SOCIAL AND NATIONAL DEVELOPMENT

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ABSTRACT: *Proximity Intruder Security Alarm system, as the name implies, is a system that detects an intruder within a proximity up to two meters range within an unauthorised area. It is a system that alerts security personnel, residents of an environment, and of course scares hoodlums away. This innovative work carried out 4 different tests on 3 types of sensors to ascertain their extent of coverage. The tests were carried out on ultrasonic sensor, infrared sensor, and linear sensor. The test analyses shows that ultrasonic sensor has a longer distance up to 1.8 meters and wider radius coverage of 360°, linear sensor 1.5 meters, 90°, and infra-red sensor 1 meter, 90°. The following components were used to achieve this laudable innovative work: linear, infra-red or ultrasonic sensor any of the sensors can be used along with contactor, revolving light, control box, auxiliary contacts, alarm, reset switch, pilot lamps, sling, hard object, motor, limit switch and power cord. It was concluded that criminality and insecurity had continued to subject private homes, business offices and industrial areas into state of dilemma, dwindling social and economic development of the nation. The following recommendations were proffered, that the system should be installed in places like residential, commercial areas, industrial, mini stores, super market, banks, all dwellings areas for protection against burglary, (theft) or property damage, as well as personal protection against intruders.*

Academic Discipline: This research work derived its design principles and finally the construction from the fields of Electrical/Electronic Engineering

Research Type: This research used an experimental method to elicit needed findings in the work.

INTRODUCTION

Security is the degree of resistance against, or protection from harm, (Taneh, Robinson, and Kpabep 2015) in (Schneier 2010). This mostly affects industries, valuable asset, individuals, organizations dwellings, nations, or communities. Security issues in a nation like Nigeria, is a critical one that needs technological outfit like this to protect everyone. It has gone to the extent that business areas are forced to close earlier than expected day by day, subjecting all residents in to daily phobia. It cuts across simple burglary theft to carrying serious sophisticated weapons used in terrorising the environment. Perception and conclusion of security in different quarters has increased drastically and has raised serious objection as regard the day to day living amongst neighbours in particular and the society at large. This lack of security has become a great menace that life and properties are no longer safe. Besides, small scale businesses are beginning to suffer great loss, since their business shops, supermarkets, boutiques; even commuters are no longer able to operate effectively in a given environment and are constantly falling victim due to intruders who constantly burgle them. Although there had been several measures to put an end to this incessant harassment, however developing one that will automatically alert security personnel, neighbours, and quickly scares an intruder away is very important to deter the malicious behaviour of burglary. Criminality and Insecurity had continued to subject private homes, business offices, Banks, and industrial areas into state of dilemma. To curb this ugly trend, especially the constant break and entry by intruders, some devices been installed such as:

Linear Electronic Device that emits radiation in order to sense some aspect of its surroundings detected signal enters the sensor itself at the center of the device. This part comprises of more than one individual sensor, which is made up of pyroelectric materials, either natural or artificial. These are materials that generate an electrical voltage when heated or cooled. These pyroelectric materials are integrated into a small circuit board. They are wired in such a way that when the sensor detects an increase in the heat of a small part of its field of view, it will trigger the motion detector alarm. It is very common for a linear sensor to be integrated into motion detectors, which is why it is suitable for this research, which can be used for residential or commercial security system.

Most Motion Detectors are fitted with a special type of lens, called a Fresnel lens on the sensor face. A set of these lenses on a

motion detector can focus light from many directions, giving the sensor a view of the whole area. Instead of Fresnel lenses, some motion detectors are fitted with small parabolic mirrors which serve the same purpose (Tim and William 2001). Some alarm systems serve a single purpose of burglary protection; combination systems provide both fire and intrusion protection. Intrusion alarm systems may also be combined with closed-circuit Television surveillance systems to automatically record the activities of intruders, and may interface to access control system for electrically locked doors. Systems range from small, self-contained noisemakers, to complicated, multi-area systems with computer monitoring and control. A wide variety of systems are available, but they are all based on the same basic design principles using different types of sensors. Circuit alarms work well for guarding the outside of a building, where obvious points of entry like doors and windows can be alarmed. They are also called security alarm, security systems, alarm system, intrusion detection systems, perimeter detection systems and similar terms. Having all these types of intruder security systems in place, no one had incorporated a hard dropping object. This research work has come up with a device called **Proximity**

Intruder Security Alarm Light and Objects System (PISAROLS). PISAROLS is a system designed to detect intrusion and infringe injury on unauthorised break and entry into building or any area. Wulfinghoff (1999), subscribe to the idea that scalding injury is a serious concern in many societies of world, which this research also target to project. Based on the area to be used, it can be designed with ultrasonic sensor, infra-red sensor, or linear sensor with hard dropping object at a target point. This is an innovation as contribution to knowledge.

Concept of Sensors: The sensor is such that it is made up of tiny parabolic mirrors to extend their sensitivity rang to a broader horizon such as automatic light switch. When someone steps into the horizon of the sensor, its curved radius of several minutes of focusing ability can take weak light signals received from multiple angles, which will be channeled into one focal point on the sensor. It also does perceive motion by detecting the heat generated by a moving human body.

OBJECTIVES
Social and economic development or growth of a place or Nation is realised through sustainable investment in that place. Taking cognisance of these, the

purpose of the study deems it fit to ascertain measures that can:

- scare hoodlums away,
- alert environs,
- alert security personnel,
- hard object to cause injury on an intruder,
- to bring sanity in to our society,
- to achieve some level of Sustainability in any given investment,
- and protection of lives.

Design Considerations

- ➢ Hoisting stability
- ➢ Hoisting speed
- ➢ Proportionality of speed
- ➢ Efficiency of motor
- ➢ Fail safe design principles

Safe Design Consideration

Safe design is said to be the integration of hazard identification and risk assessment methods early in the design process to eliminate or minimise the risks of injury throughout the life of the product being designed. It encompasses all design including facilities, hardware, systems, equipment, products, tooling, materials, energy controls, layout, and configuration (AS&CC 2006). In line with the above definition, the under listed were made possible:

- ❖ Provision of limit switch
- ❖ Provision of reset switch
- ❖ Provision of adequate rollers
- ❖ Provision of effective earthing system
- ❖ Provision of stopper

Design Calculation

Considering hoisting stability, efficiency of the motor is calculated as mechanical output power divided by electrical input power; this implies that

E = Pout / Pin

Therefore

Pout = Pin * E

after substitution we get

T * ω = I * V * E

T * rpm * 2π/ 60 = I * V * E

and the formula for calculating torque will be

T = (I * V * E *60) / (rpm * 2π)

Measure current, voltage and rpm. Now you can calculate the torque for this load at this speed assuming that you know efficiency of the motor. Our estimated 15% efficiency represents maximum efficiency of the motor which occurs only at a certain speed. Efficiency may be anywhere between zero and the maximum; 1000 rpm can be used, but it may not be the optimal speed. The motor is design for optimal speed of 1450 rpm so the for the sake of calculations you may use 10% efficiency (E = 0.1). The hoisting speed is also controlled with the

weight of the load, while object dropping speed remains constant. Motor torque changes with the speed. At no load we have maximum speed and zero torque. Load adds mechanical resistance. The motor starts to consume more current to overcome this resistance and the speed decreases which is used for proportionality speed. If we increase the load at some point beyond the motor torque capacity it will stop. (This is called stall). While speed, current, and voltage could be accurately measured, efficiency of the motor may not be correct. It depends on the accuracy of assembly, sensor position, friction, alignment of the motor, weight of load and roller angle. In actual sense at stall speed there is no back emf, and at no-load speed, the back emf is equal to the driving source voltage. The current flowing through the motor can be calculated thus:

$$I = (V_S - V_{emf})/R = (V_S - ki*\omega)/R$$

V_S = source voltage

R = motor electrical resistance

Now mechanical consideration of the motor. The torque generated by the motor is proportional to the amount of current flowing through the motor:

$$\tau = kt * I$$

kt = a constant

τ = torque

Using the above electrical model we can verify that at the stall speed the motor has the maximum current flowing through it, and that gives maximum torque. Also, at the no load speed the motor has no torque and no current flowing through it. The above consideration gives us the efficiency the motor.
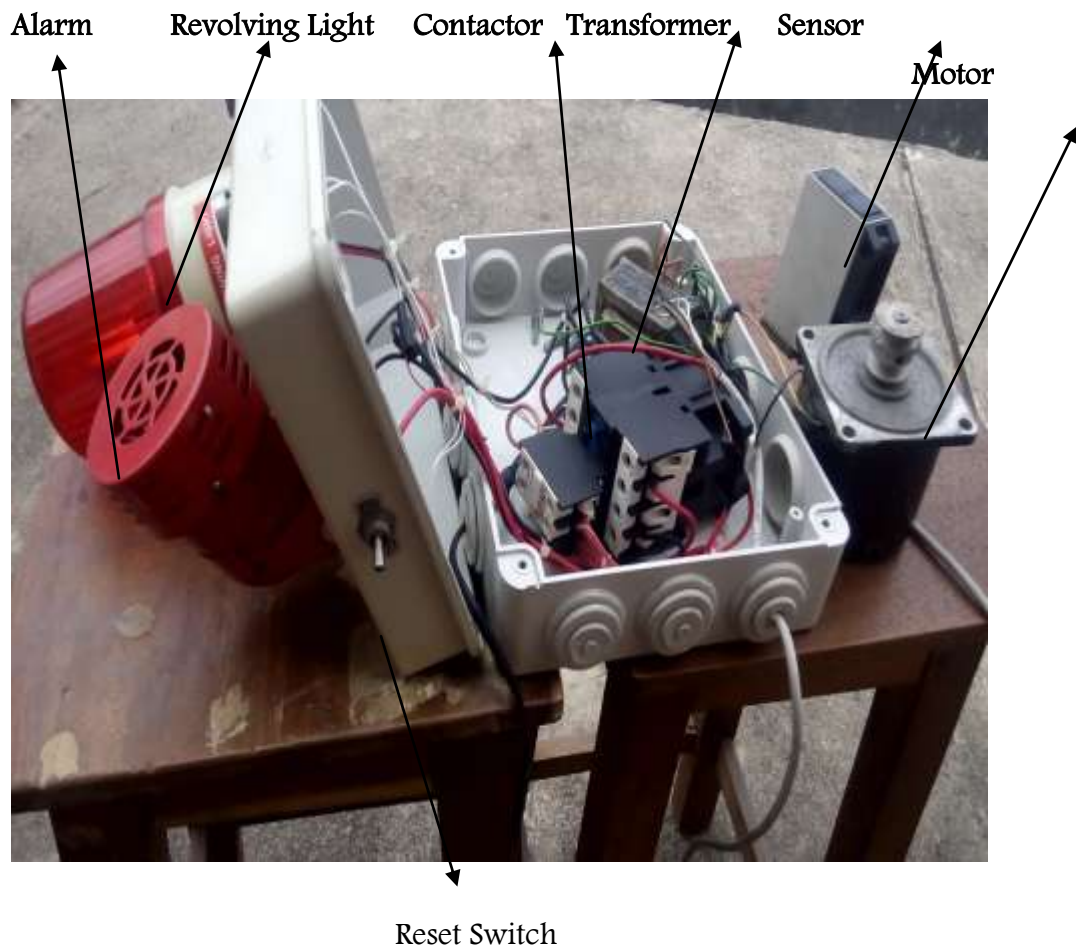
Motor Parameters

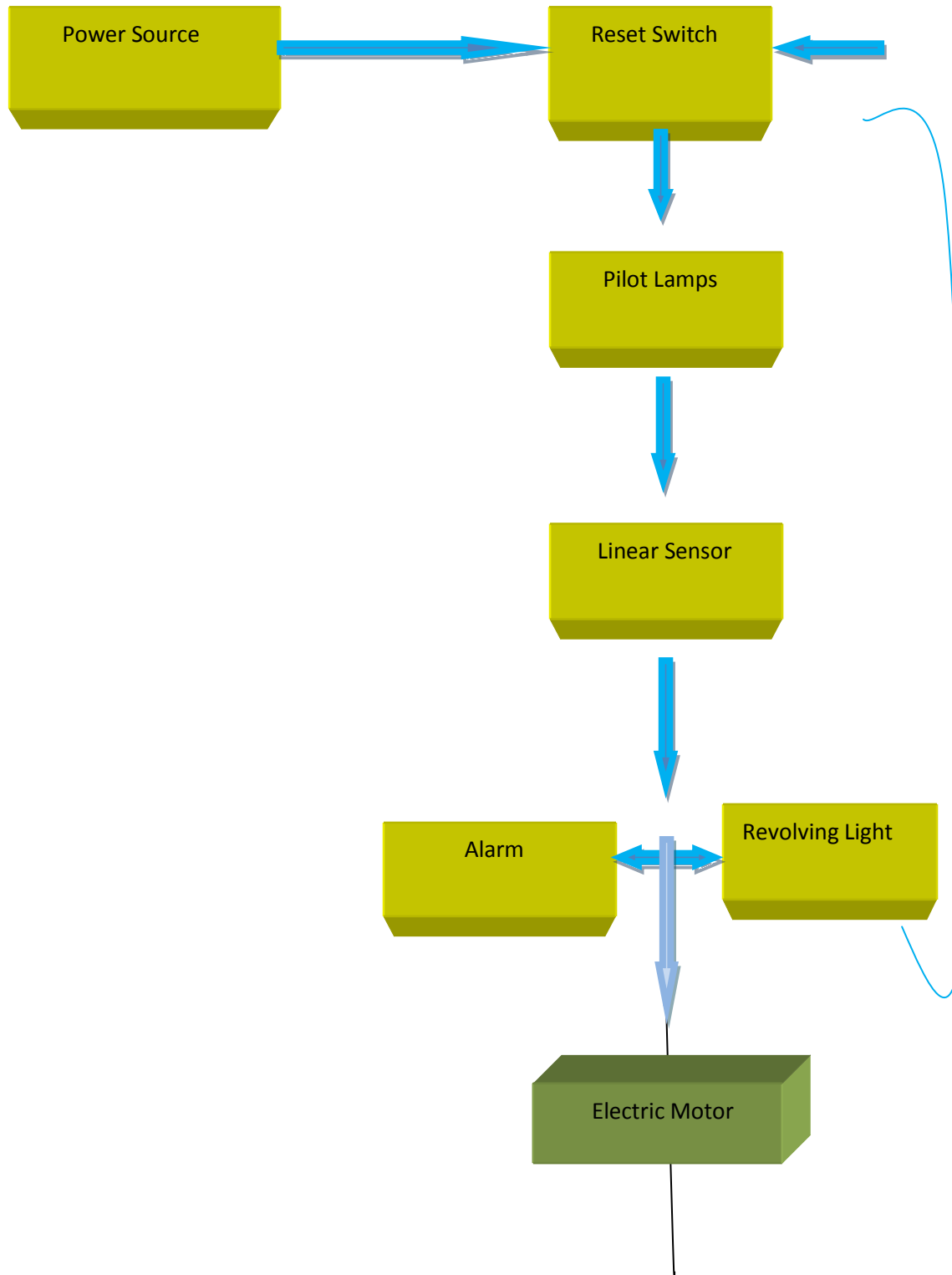Power = 20w

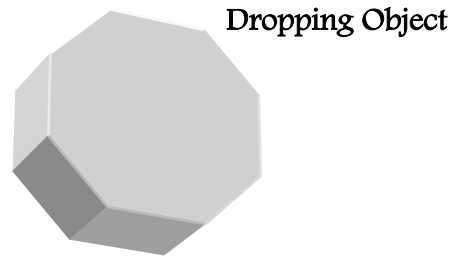Current = 0.5A

Voltage = 100/110v

Freq = 50Hz

Speed = 1450rpm

Design Method

The study adopted research and development (R&D). This is presented in 3 detailed procedures, the operation connection, float diagram and bar chart analysis. The design operational method are carried with the use of reset switch, contactor, No/Nc auxiliary contacts, electric motor, sling, roller, pilot lamp, revolving light, hard object, alarm, step-down transformer and limit switch.

Pisarols Operation Connected Control Box

Power Source → Reset Switch

Reset Switch → Pilot Lamps

Pilot Lamps → Linear Sensor

Linear Sensor → Alarm / Revolving Light

Alarm ↔ Revolving Light → Electric Motor

Dropping Object

Pisarols Operation Float Diagram

CONSTRUCTION PROCEDURE

❖ Drilling of Control Box: This is done to create space where components can be installed.

❖ Fixing of Panel Rail: This is the provision made for the stability of contactors and relays.

❖ Fixing of Components in Control Box: It is the linking of needed components to achieve the desire goals.

❖ Mounting of the Sensor at the Target Point: As one of the basic components, a determined distance and position is earmarked for set target.

❖ Mounting the Alarm at the Target Point: The alarm which alert the environment, those at a distance or in an enclosure, is installed such that, the sound should be loud enough to realise the purpose of the study.

❖ Mounting of Revolving Light at the Target Point: The Revolving lamp enable those who have hearing problem and those at far distance who could not hear the sound of the alarm to know that the area is not safe at the moment.

❖ Connecting the Component in Line with the Design: This is strict compliance to the purpose of the research, by connecting all

components according to specification.

❖ Power Cable Connected: Having confirmed that all specifications are attended to, then the power cable that brings in the main supply, is connected.

❖ Rest Switch: It is acknowledgment switch used in turning off alarm and to reset to the formal state when normalcy has returned to the environment. Used in putting off the system at normal working hour

❖ Mounting of Motor: The motor can be base or suspended mounted.

❖ Hard Object: A pendant object with reasonable weight is hocked with sling through roller at the shaft of the motor above a target point.

❖ Limit Switch: Limit switch is used to stop vertical hoisting at desired point.

❖ Step-Down Transformer: To reduce input voltage of the motor so as to reduce hoisting speed

TESTING ANALYSIS
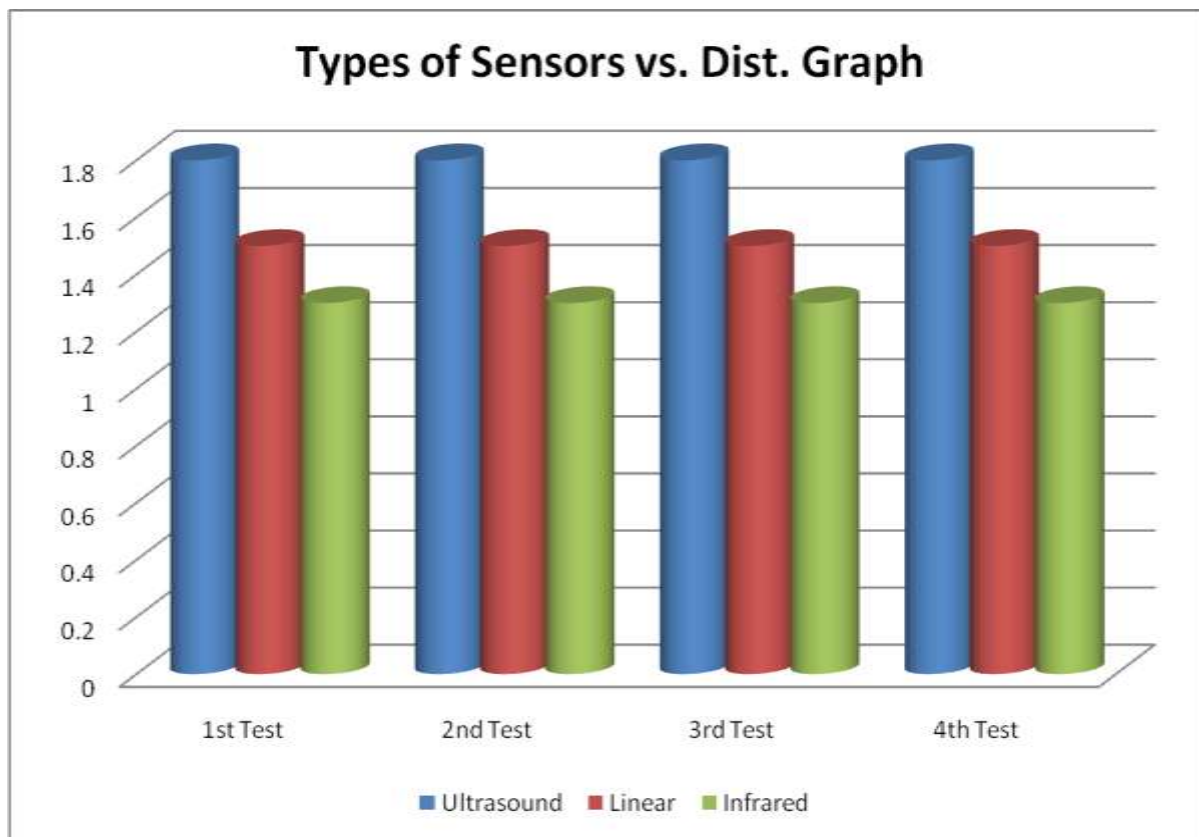
Pisarols Bar Chart

Testing of the device were done stage by stage, first manual testing, followed by using necessary instrument, such as resistance meter, ammeter, voltage meter, proximity test, distance measurement, simultaneous test of alarm with revolving light and dropping of object. 4 test were carried out on 3 different types of sensors and their respective distance of sensitivity were ascertained.

RESULT

The result realised from the entire test were satisfactory and in line with the design. The proximity sensor activated at the distance of 1.8 meter for ultrasound sensor, 1.5meters for linear sensor, and 1.3meters for infra-red sensor by which the alarm, revolving light, and dropping object activated at the same time.

CONCLUSION

Increase in criminality rate, and dwindling level of business in our environment, actually required proximity intruder security system to be installed in all sensitive areas in our country. This will enable local and International industries to thrive and automatically instil confidence in every one doing business within our

environment and at large promote social and national development.

RECOMMENDATION

In a very strong term, Proximity Intruder Security alarm light and object system **(PISAROLS)** is recommended to be installed in all sensitive areas, such as Banks, Industrial areas, Hotels, Residential homes and all other public places. This will enhance sustainable development and reasonable level of secured environment. It can also be modified with the use of timer relays, gate, door, and net to get intruder trapped in a confined place.

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