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AN EXPERIMENTAL STUDY OF SENSOR BASED SMART STRUCTURE DESIGN: A MODAL STUDY

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ABSTRACT

The Aim of the present study was to extol about advantages and applications of smart structures. Smart materials are important ingredients in present scenario Structures. Vital materials used in Smart Structures are Smart materials such as optical fibre based sensors, smart fluids, Ferro-magnetic Sensor's, shape memory alloys, Piezo-electric sensors. Smart materials which have the functions of actuator, sensor, self-healing and so forth, are to be used not only as advanced functional Materials but also as key materials to provide structures with smart functions. Smart systems sense the changes in the structure variations in vibration, noise and temperature. Processes the information and then responds appropriately to automatically correct deferential problems. They alert the structures to correct the malfunction, prevent damage and optimize performance. In the absence of mankind's vigilance it does its own vigilance.

Key words: Smart Materials, Smart Concrete, Sensors, LDR (Light Dependent Resistor), Actuators.

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1. INTRODUCTION

A structure which is capable of thinking on its own and able to repair on its own is said to be smart structures. These are globally used as wireless data collection solutions to determine pile capacity and integrity in real time. It is also used as environmental control, security; structural health monitoring it consists of multi-functional parts which can perform actuation, sensing and control. We can imply it as an analogue of an enhanced biological body. Smart materials are designed materials that have one or more properties that can be significantly changed in a controlled fashion by external stimuli, such as stress, temperature, moisture, pH, electric or magnetic fields. Smart materials have properties that react to changes in their environment. This means that one of their properties can be changed by an external condition, such as temperature, light, pressure or electricity. The change is reversible and can be repeated many times. The Structures constructed on clayey soil prone to differential settlement are Consolidation in clay is very slow Clay has high swell-shrink nature. The conventional methods adopted to overcome this problem are under reamed pile foundation, providing water proof apron and replacing a layer of clay with CNS. The smart ways of preventing settlement are volume of clay remains unchanged if optimal moisture content is maintained. Smart Way of Resisting Earth Quake are Magneto-rheological fluid is a smart material which changes from liquid to solid when exposed to magnetic field. When this fluid is filled in a cylinder and exposed to alternate magnetic it can act as a damper for shock waves. An ultrasonic device is used to detect the seismic waves. It is converted into AC current and passed to dampers. The solid-liquid transformation takes place at a frequency corresponding to that of seismic wave. The seismic wave is destructively interfered and the building is prevented from shock. Smart Way to Check Corrosion are A thin metal foil of non-corrodible material is provided surrounding the reinforcement bar, The metal sheet is given with positive potential and the rod is given negative potential, When the reinforcement increases in diameter it comes in contact with the foil, Now electroplating takes place in reverse direction. advantages of the smart structures This structure cut downs a lot of material cost incurred in using under reamed pile and factor of safety, India has 25% of area prone to earth quake. This smart technology will help in saving a lot of men and Material, The health monitoring of structures will help in forecasting failure and will provide time for re-habitation, 35% of Deccan plateau has black cotton soil the use of this technology can ensure safe and economical construction over there, As the structure is constantly maintained the service life increases and the need for repair decreases.

2. OBJECTIVE

1) Design of LDR (Light Dependent Resistor) Sensors

2) Utilization of LDR (Light Dependent Resistor) sensor in residential building

3. METHODOLOGY

3.1. Materials

Auto adaptive materials which are used in construction of smart structures are

- piezo-electric materials
- shape memory alloy
- smart concrete
- Smart fluids (magneto-rheological &electro-rheological fluids.)

3.1.1. Piezo-Electric Materials

These materials produce a voltage when stress is applied. Since this effect also implies in the reverse manner a voltage across materials are materials that produce a voltage when stress is applied. Since this effect also applies in the reverse manner, a voltage across the sample will produce stress within the sample. Suitably designed structures made from these materials can therefore be made that bend, expand or contract when a voltage is applied.

3.1.2. Shape Memory Alloy

Shape-memory alloys and shape-memory polymers are materials in which (pseudo elasticity). The shape memory effect results due to respectively martensitic phase change and induced elasticity at higher temperatures.

3.1.3. Smart Concrete

Stronger than conventional concrete, it is reinforced by carbon fibres as 0.2% to 0.5%of volume. To increase its sense ability to stress or strain, while still has good mechanical properties by adding small amount of short carbon fibre into concrete with conventional concrete mix.

3.1.4. Smart Fluids

The properties of fluids are changed by applying an electric filed or a magnetic field. Viscosity increases when a magnetic field is applied. Small magnetic dipoles are suspended in a non-magnetic fluid

3.1.5. Smart Structures Integrate Various Elements such as

- sensors
- actuators
- power sources

3.2. Process of Methodology

At First we are considering a general residential building to which we are going to add an LDR Sensor to the door's of Building. The Sensor works on principle of light intensity and the Sensor Design consists of transistor which gets on and off which is completely dependent on the relay and motor, when the light intensity fall on the sensor the transistor gets on and the relay generates power through it which results in the rotation of the motor and this helps in the opening and closing of doors. The way of introducing the Sensors in the residential building leads to the construction of the smart Structure, Which is able to analyze and react to it-self. For example the automatic opening and closing of doors in the presence and absence of the humans based on the shadow falls on the doors which is objected by light and the LDR sensor gets into role and performance of the sensors directly leads in the actions of the doors.

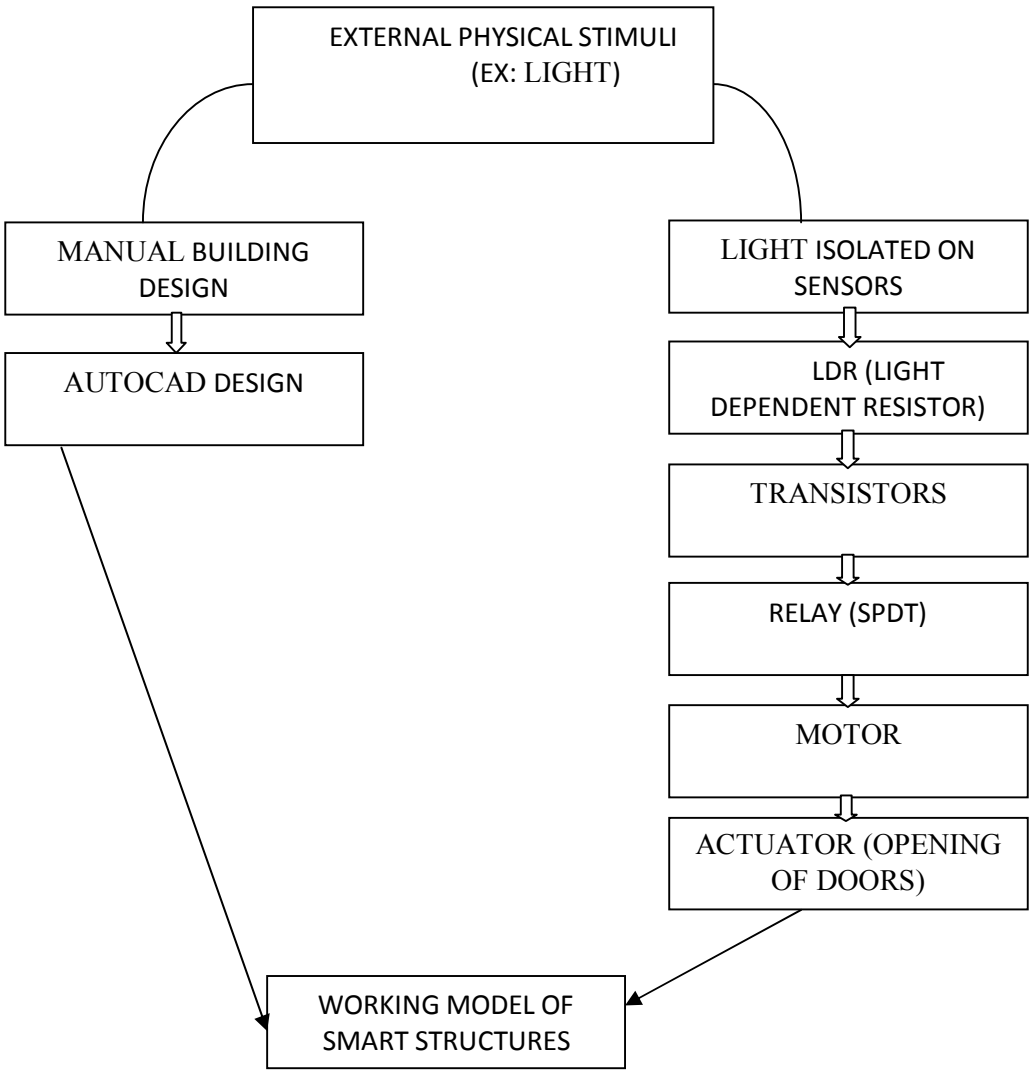

Figure 1 Flow Chart Showing the Step by Step procedure of Methodology

4. RESULTS AND DISCUSSION

The circuit diagram present here is that automatically opens and shuts OFF the door based on light intensity falling on the sensor. The circuit uses a LDR (LIGHT DEPENDENT RESISTOR) to sense the light .When there is light the resistance of LDR (LIGHT DEPENDENT RESISTOR) will be low. So the voltage drop across POT R2 will be high. This keeps the transistor Q1 ON. The collector of Q1 (BC107) is coupled to base of Q2 (SL100). So Q2 will be OFF and so do the relay. The motor will remain OFF. When shadow falls on the LDR (LIGHT DEPENDENT RESISTOR) Sensor the voltage increases to make the voltage across the POT R2 to decrease below 0.6V. This makes transistor Q1 OFF which in turn makes Q2 ON. The relay will be energized and the motor will rotate and door opens.

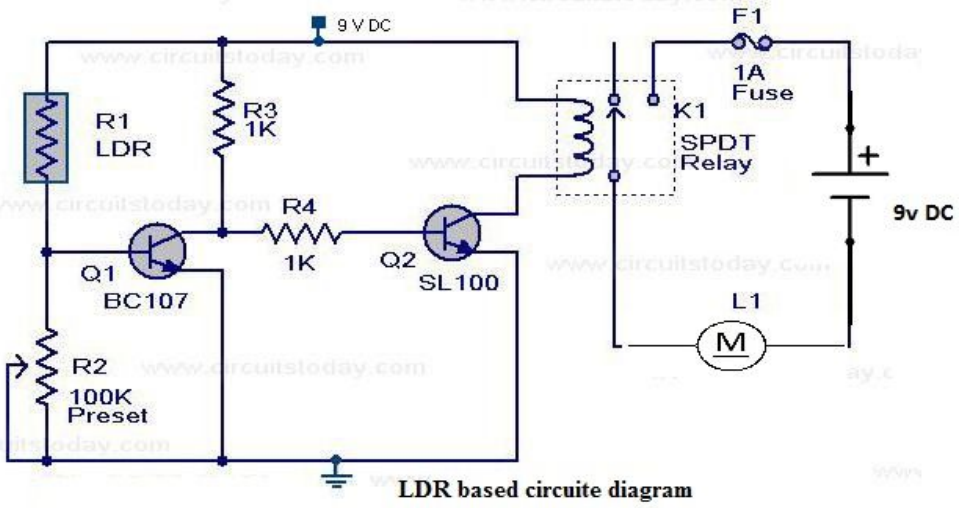

Figure 2 Circuit Diagram

The components used are 9V DC Batter, L.D.R Sensor, BC 107 SL 100, SPDT-RELAY, Variable resistance of 100KΩ, P.C.B (Printed Circuit Board of 555 or Vero-board), 12V Motor, Fuse.

4.1. Analysis of Operation

Initially we have taken a senor named LDR (Light Dependent Resistor) and a variable resistor for the varying of the intensity as per required. These sensors are attached to doorways such that when persons enter through the doorways the shadow falls on the sensor which isolates the light source which is coming from the opposite direction of the sensor, with which the sensor gets into function. When shadow falls on the LDR (Light Dependent Resistor) the voltage drop across POT R2 will be high. This keeps the transistor Q1 ON. When shadow falls on the LDR (Light Dependent Resistor) it increases to make the voltage across the POT R2 to decrease below 0.6V. This makes transistor Q1 OFF which in turn makes Q2 ON. The relay will be energized and the Door will be opened. This is how the analysis of operation is abbreviated into physical form.

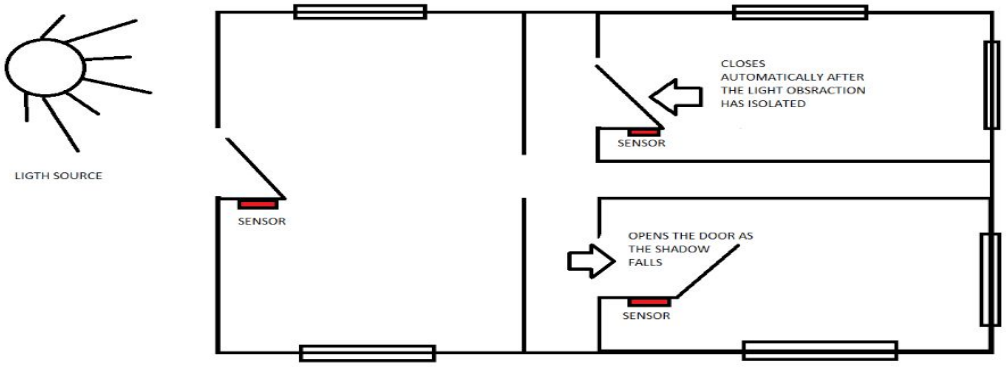

Figure 3

The result which is drawn with prototype we have made is the door automatically opens when the shadow has fallen on the LDR (Light Dependent Resistor) sensor and closes as soon as the light obstruction has isolated on the LDR (Light Dependent Resistor) sensors. The smart structure by its nature is highly interdisciplinary filed computes of electronics, construction and partially robotics in it .The problems can be sleeked at any real time. It is

used in both new constructions and also for enhancements of the existing constructions. In the present scenario the most promising technologies for the life time efficiency and improved reliability includes the smart materials and structures.

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