AUTOMATED SWITCHING BOARD USING LASER

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Abstract— **Automated Switching Board using Laser is a type of switching circuit which uses laser light for the operation of switching on and off the appliance. To operate any appliance, present in a room the user turns on the laser light [controller], this laser is to be incident at an angle of positive and negative 45 degree on the switch of the appliance for 3 seconds, this 3 second allows to photo detector to get active and hence pass a signal to the Microcontroller, it works as switch and changes the current state of the appliance from ON state to OFF state or vice versa. Use of Arduino UNO makes device more energy efficient and to avoid unreasonable switching of circuit. Worldwide number of automated devices is projected to increase to 43 billion by 2023, an almost threefold increase from 2018. Seeing the conditions of current pandemic this switch requires least of the human interference in order to operate it. Thus, an idea was developed to advance the background of regular electrical switching to laser operated switching board; this would resolve the traditional problems related to the switching board also use of laser ceases the need of advanced technology which can be confusing for non tech savvy people.**

Keywords—**Laser Switch, Microcontroller, Switching Appliances, Laser Receiver, Photodetector**

I.   INTRODUCTION

These days home automation makes the usual human life much easier. One such idea can help in improving the human life is Automatic electrical switch using laser. This project would mainly facilitate the old age and disabled people who are restricted by their physical problems. Such a device would enable people with physical limitation and those old, to perform the painstaking electrical switching operations of the daily household chores that require them to physically touch the appliances to control. This electrical switch allows the user to control the switching of appliance, while resting in their comfort zone, and avoid the need to displace their position just to switch ON or OFF a particular device. These ON and OFF conditions can be operated and monitored using microcontrollers. Laser is used to control the switches and can be operated from wider angles in the room; at such time unwanted switching is likely to occur and there are many challenges which needs a brief explanation.

These days embedded circuits and IOT technologies are being used for making electrical circuits work automatically but these circuits are expensive and not everyone can buy these systems. Thus, the system used to build this project is affordable for all and can be used by people of all age groups

II.   RESEARCH WORK

A remote-control system using the Radio Frequency technology utilizing multiplexers, demultiplexers, encoders, decoders, and Radio Frequency module is designed in [6: Advances in Science, Technology and Engineering Systems Journal Vol. 2] with the analysis of various technologies which can be used for the development of a remote-control system. A security system is incorporated in this remote control to provide a secured usage of the system from about ten meters away.

The work of [2: Development of a Light Dependent Automatic- Off Timer for House Holds Electronics] provides insight about automatic disconnection of the appliances from the alternating current (AC) mains supply upon the end of a pre-set time delay period. The system works by detecting a transition from light to darkness in a room, that triggers the device into a time-out mode. During the time delay period, the appliance such as CD (Compact Disk) player which is connected to the mains supply. It is observed the disconnection occurring after the pre-set time delay period elapses.

A circuit in operational conditions from 500 meters and was found satisfies though it can be controlled and aiming the laser beam exactly on to LDR is a practical problem is studied in [4: Laser controlled on/off switch]. In the work of [3: Short communication design and construction of a laser-controlled switch circuit], the circuit is designed to prove the possibility of operation at different loads, by using the laser as a switch and different laser wavelengths can be used to turn ON or OFF the circuit at the visible region and near infrared, or at certain laser wavelengths. Also, it is seen that laser switch for the people with physical limitation and those old, to perform the painstaking electrical switching operations of the daily household chores that require them to physically touch the

appliances to control [1: Design and construction of a laser switch based electrical control circuit].

The study of the trigger mechanism of LTVS is not only beneficial to promoting its practical process, and also conducive to both the optimization and the miniaturization. In this paper, the study of LTVS which has a composite trigger electrode made of potassium chloride and titanium is done.[12:Study on the trigger mechanism of a laser triggered vacuum switch] The paper, IOT BASED Home automation using smart swatch has designed a switch which can manage the on/off electrical reception by internet The smart switch is connected to mobile, laptop through internet access and the users can automatically select the switch to be switched on/off [13: IOT Based Home Automation Using Smart Switch.]

The goal of [12: Study on the trigger mechanism of a laser triggered vacuum switch] is to build a device that is significantly more powerful than existing technology but also can operate at very high frequencies. It is observed that it works in a unique mode, where the the input pulse of the laser can actually be greater in time than output pulse — almost like a compression device

III.   METHODOLOGY

A.   **System Design**
- The proposed switches can be easily operated by using laser having wavelength of 650 nm. The system can be turned ON and OFF using same laser. The ON and OFF conditions can be operated and monitored using microcontrollers.
- The laser can be operated from wider angle in the room, for this lens is being used for deciding the focal point which can direct the laser light to the laser receiver. To make use of Microcontrollers to give proper command to the switching circuit.
- To reduce Human Efforts. the laser light is incident on Laser Receiver for 3 seconds. The receiver captures the light and senses the whether there is any human presence in the room within the radar of 5m. Microcontrollers can be used to sense the input obtained from both the sensors. Then the command for High or Low can be operated as an output.
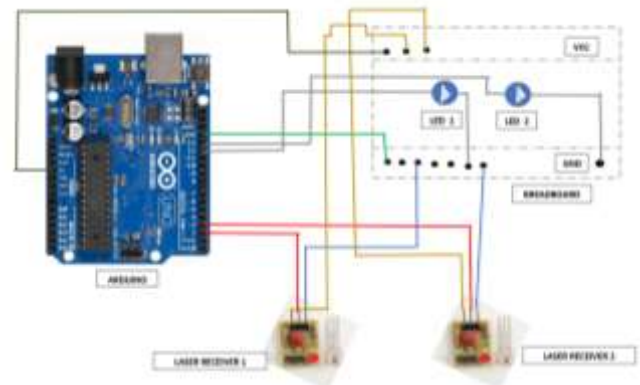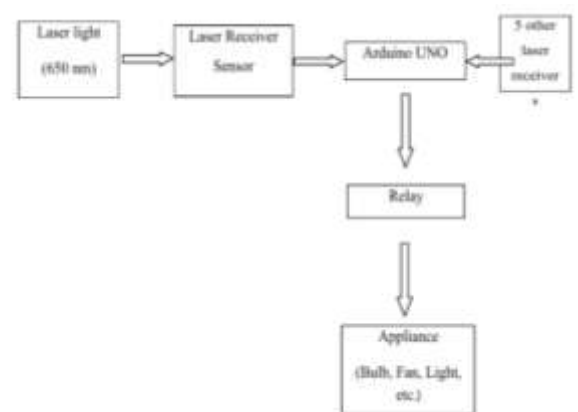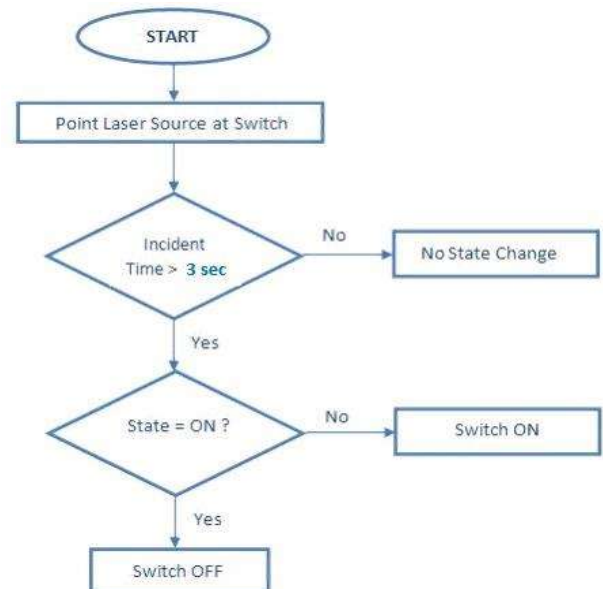

Fig.1. Circuit Diagram

Fig. 2. Data Flow Diagram

B.   **Flowchart**

C. Hardware Requirement
i. Arduino UNO:

Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output. Arduino UNO features AVR microcontroller Atmega328, 6 analogue input pins, and 14 digital I/O pins out of which 6 are used as PWM output. This board contains a USB interface i.e. USB cable is used to connect the board with the computer and Arduino IDE (Integrated Development Environment) software is used to program the board. The unit comes with 32KB flash memory that is used to store the number of instructions while the SRAM is 2KB and EEPROM is 1KB. The operating voltage of the unit is 5V which projects the microcontroller on the board and its associated circuitry operates at 5V while the input voltage ranges between 6V to 20V and the recommended input voltage ranges from 7V to 12V.

Fig 3. Arduino UNO\

ii. Relay:

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit. A simple relay consists of wire coil wrapped around a soft iron core, or solenoid, an iron yoke that delivers a low reluctance path for magnetic flux, a movable iron armature and one or more sets of contacts. The movable armature is hinged to the yoke and linked to one or more set of the moving contacts. Held in place by a spring, the armature leaves a gap in the magnetic circuit when the relay is de-energized. While in this position, one of the two sets of contacts is closed while the other set remains open.

When electrical current is passed through a coil, it generates a magnetic field that in turn activates the armature. This movement of the movable contacts makes or breaks a connection with the fixed contact. When the relay is de-energized, the sets of contacts that were closed, open and breaks the connection and vice versa if the contacts were open. When switching off the current to the coil, the armature is returned, by force, to its relaxed position. This force is usually provided by a spring, but gravity can also be used in certain applications. Most power relays are manufactured to operate in a quick manner.

Fig 4. Single Channel Relay

iii. Laser Receiver:

The 3-pin sensor is actually a minuscule light sensor (receiver) diode with an integrated amplifier and an open-collector transistor at its output. Output of the module, designed to operate on 5VDC power supply, can only go low (L), and the open-collector transistor inside the 3-pin sensor can sink about 20mA current. The description poor Chinese description "non-modulator tube" actually points the fact that the light sensor can handle any source of light and it's not like a 3-pin infrared sensor module (TSOP1838 for example) that only detects an infrared pulse train within a particular frequency band.
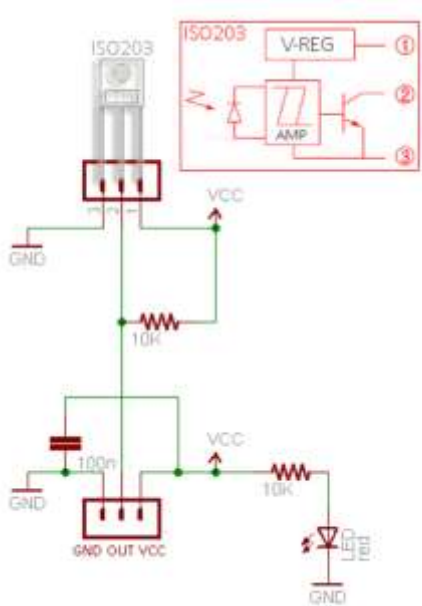

Fig 5. Laser Receiver Module

Fig 6. Laser module circuit

These are the three main models which are important for the circuit to work properly. Other requirements for circuit completion are USB cable, wires breadboard and electric supply.

D. **Survey Research**

A survey research i.e. Social research and Market research is conducted to find out about the characteristics, preferences, opinions, or beliefs of a group of people on this proposed work.
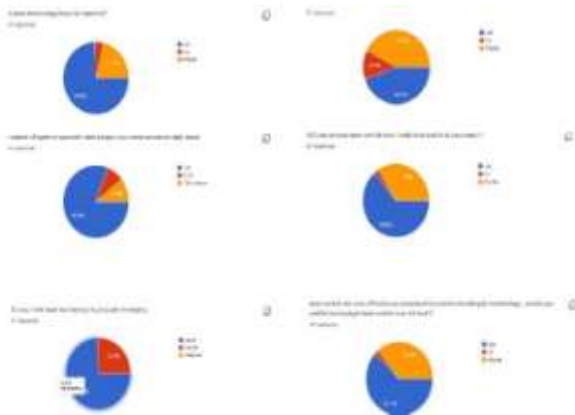
• **Social Research**

Fig.7. Social Survey Research

Through these survey questions people were asked about their comfort with using laser-based switches at home. To which the responses were received as above. Most of them believe

laser technology is boon to mankind and can be made use of for such projects. Many of them come across old age and physically challenged people, to make things easy for any such people laser switches are reliable and cost efficient. The new laser switch that is brought into existence can make people pave through the upcoming technology. Almost 44% people believe that laser switches can be used by all the age groups whereas 42% people think that it maybe not feasible for all the age group to use laser technology. Over 63% people would like to have laser switches instead of normal ones. 61% people think that laser switches are affordable over IoT technology and would prefer laser switches over automated IoT handled switches.

• **Market Research**

Fig.8. Market Research Survey

Various industry experts gave their opinion on this proposed work. Through these survey response, the need of the company is known and their requirements. They feedback paved a valuable input to this designed device.

E. **Figures and Tables**

The product is feasible and easy to operate. It does not require any complex operating system.

TABLE 1: FEASIBILITY STUDY

Types	Study
Market Feasibility	Useful for household switching and other switching.
Operational Feasibility	Easy to use

Capacity Utilization	Can be utilized instead of regular household switches
Financial Analysis	Affordable and low maintenance cost
Competition	IR switches, Voice controlled switches.
Social Effects	Automated switches can be used by all age groups without any hazardous effects, along proper operation of the switch.

IV. RESULT AND DISCUSSION

The proposed project's goal is to provide electrical switches for light bulbs, fans, and other household equipment. To replicate the effect caused by a 230V 50Hz A.C. supply, the electrical control circuit was created on a breadboard using the components indicated in Chapter 4 and an appliance with the A.C. signal delivered from an Arduino.

A. The following results were obtained pertaining to the circuit modules designed in the proposed paper

Fig 9. Stage one of circuit development

It is observed that whenever the laser source is pointed toward the switch the response time of the circuit is expected between 0-5 seconds. The laser should be pointed to i.e., on the light sensor present in the laser detector; for a minimum period of 3 seconds. Once the laser light is detected by laser receiver, then it checks for the command from Arduino to act further based on that. Basically, Arduino is used as a microcontroller which usually takes analog input commands from the laser receiver and acts accordingly. The input received by Arduino it commands relay to switch on or off the device attached. All this to achieve using a single receiver for each switch.

Laser receiver captures laser beam and sends analog signals to the microcontroller i.e. Arduino UNO. Laser light is used as a remote control like human arm is used to switch appliance ON or OFF. There are four switches port made for bulb connected on the switchboard. With practical implementation, it is observed that there is no overlapping of switches with other switches on board when tries to turn on or off.

The following observations were obtained pertaining to the source code used to design in the proposed switch
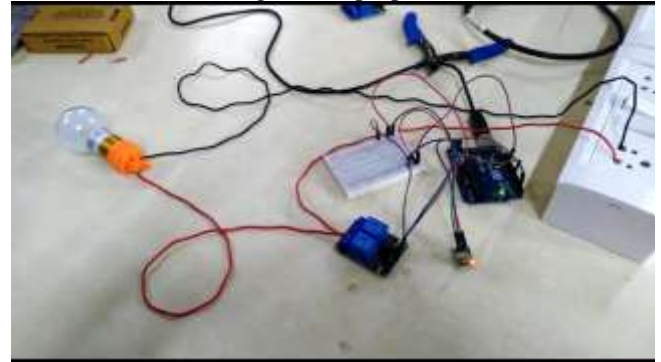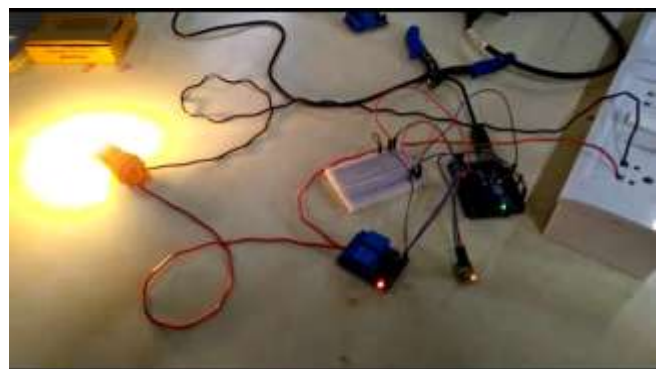

Fig 10. OFF State Circuit

Fig 11. ON State developed Circuit

This laser module are programmed and combined with an Arduino board, allowing it to be utilised in a number of real-world scenarios. From the source code, "delay (3000)" means that the duration goes for 3 seconds. Both "digitalWrite (LaserPin, HIGH)" and "digitalWrite (LaserPin, LOW)" states that when the input voltage is high or low, which light up or fade out the Laser Diode respectively. The expected outcome should be:
1. The Laser Diode light up for 3 seconds.
2. The Laser Diode fade out for 3 seconds.
3. Repeat the 2 steps above until stop supplying the voltage into Laser Diode Module.

V. CONCLUSION

In the proposed design, a unique laser switch-based electrical circuit based on the application of a visible-region laser; on a laser-based detector is provided. The suggested laser switch is made up of a detector that detects the laser, an Arduino that controls the appliance, and a relay that acts as a latch. Tub Sensor Receiving Module with Laser Non-Modulator Laser output High Level is an Arduino sensor that receives laser output and converts it to digital data. When the output level is high, the module receives a laser signal; when the output level is low, the module does not receive a laser signal. When a

laser signal is detected, the output is raised to a high level (5V) until the laser signal is detected. The Relay operates as a latch that is set (ON) or reset (OFF) by a pulse voltage input and is also used to manage a big current flow with a smaller current. Laser technology is boon to human life. In this approach, the electrical control circuit can help people who would otherwise require institutional care by allowing them to utilise it in their homes and offices because it does not demand as high power and eliminates unexpected appliance switching. These switches are very helpful for old aged and physically disabled people.

Followings are the future works set to improve the system:

- By using PIR sensors in this system, it will be able to reduce the power consumed and memory space of the system.
- To save electricity from wastage.
- To alert the short circuit condition or any unpredictable situation, by placing an alarm system.
- To connect LED Display for fan regulator number.

VI. ACKNOWLEDGMENT

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