IOT BASED LOAD SENSING SEATS CONTROLLING LIGHTS AND FANS

KANDRAKONDA VIJAY KUMAR [1], M YAMINI SARASWATHI [2], B HANISH CHAITANYA [3]

Assistant professor [1], Assistant Professor [2], Assistant Professor[3]

ECE Department, Sri *Mittapalli College* of *Engineering*, *Guntur*, *Andhra Pradesh*-522233.

Abstract:- With the advent of technology, electricity now plays a significant part in our daily lives. As the demand for power rises, so does production, resulting in the depletion of nonrenewable resources, making electricity conservation imperative. People frequently leave the lights and fans in their rooms turned on, wasting energy. This study focuses on employing an energy-efficient system based on IOT and Arduino to automate the room's lights and fans. To identify human presence in the room, previous research has employed motion sensors, load cells, and IR sensors. These devices are typically large and ineffective in detecting human presence. The Force Sensing Resistor (FSR)sensor is used to present a novel load sensing approach. For force and pressure sensing, FSR combines clever, lightweight, and power-efficient technology. Our intelligent seating technology is unique, small, and energy-efficient. This type of technology will come in handy in situations where the majority of the job is done while sitting. For example, offices, schools, college classrooms, salons, residences, railroads, and so on. It would help to reduce energy costs, limit future resource depletion, improve living quality, and contribute to a greener, cleaner Earth.

Keywords:- IoT, FSR, sensor, ARDUINO, load-sensing, and energy-efficiency are some of the terms used.

I. INTRODUCTION

Nowadays, energy conservation is a top issue, and automation, thanks to technological advancements, plays a significant part in preserving energy and, as a result, natural resources. People frequently leave the lights and fans in their rooms turned on, wasting energy. Earlier research on this issue proposed a method based on counting the number of people entering the room, lighting it up based on the light intensity, and automatically turning on the fans [1]. The number of people in the room was counted using motion detectors. The PIR sensor, on the other hand, has significant flaws. PIR sensors are very sensitive to all types of motion, therefore they can detect any movement, whether human or not. As a result, it's not a particularly good sensor for detecting human presence. Furthermore, Passive Infrared (PIR), sensors detect heat signals in the room; however, if the room is heated, they are less sensitive. PIR sensors are thus used.

In other countries, such as India, it is impossible to recognize human people in the heat. Previously, all load sensing applications were used to tackle fluid mechanic concerns. As demonstrated in [2, most research focus on building a controller framework for the pump in order to preserve stability and performance.

Only a few instances exist of systems that use a sensor-based load-sensing seat to measure and regulate electrical appliances. Previous studies on this subject have used a load cell to transform force into an electrical signal. This system is rather large since it includes a HX711 load cell amplifier as well as several components such as nRF24LD1 transmitters, a relay, and an IR sensor [3]. Our technology employs a thin sheet-like sensor that is flexible, resilient, and requires very little power, making it a compact and energy-efficient solution.

Our proposed approach is based on the assumption that individuals spend the majority of their time sitting in a room while working or waiting. The lights and fans in that room may then be controlled using load-sensing of seats. It focuses on high-energy-consumption locations such as office spaces, salons, schools, and college classrooms. The proposal's features and concepts are detailed in the following sections.

II. PROPOSED SYSTEM

To control the lights and fans, we used an ARDUINO Uno, a Force Sensing Resistor (FSR), an ESP 8266, the Thing Speak cloud, and a relay driver circuit. The sensor in our system employs on-demand node activity, in which devices are linked in a system via IoT and are referred to as nodes in a system. Node activity is not planned for on-demand nodes, and they are always active with limited capabilities. It turns to active mode if it receives a wake-up signal, and data transfer occurs following activation [4].

The main load detecting element in our system is a Force Sensing Resistor (FSR) sensor. FSRs are small, flexible sensors that may be readily placed beneath chair cushions or foam. It will have no effect on the chair's comfort. The FSR406 model will be selected since it is the most extensively utilized and cost-effective. A square sensor with a detecting size of 1.75x1.5 square inches will be used. It will be put beneath the cushions in the centre of the chair. When the sensor detects a sufficient load to indicate a human load, it will send a signal to the Arduino, which will turn on the lights and fans, as well as send the component data to the cloud.

The lights and fans will be monitored with this device. A monitoring system is built up using the cloud. If the sensors fail to transmit the necessary signal, it may use voice commands to operate any light or fan. The relay would be connected to the adjacent lights and fans, allowing just those lights and fans to be turned on. Resting would be possible if someone sat near the fans and lights.

Fig 1 Schematic showing the wiring of the system in an office desk.

III. WORKING PRINCIPLE

This is a straightforward project that utilizes piezoresistive sensing technology. When a human sits in a chair with the FSR, the ARDUINO Uno receives a signal. The force sensing resistor (FSR) is a variable resistor that changes values in response to the application of force. FSR is made up of durable polymer thick film (PTF)devices that show a reduction in resistance as force is applied to the sensor's surface [5]. They're thin, flexible sensors that have been produced. It can detect extremely weak forces ranging from 10g, such as a light tough, up more than 50 kgs. The piezo resistive effect changes solely the electrical resistance of the material and has no influence on any other property. The resistance of the FSR varies when greater pressure is applied. The sensor seems to be an infinite resistor (open circuit) while there is no pressure, but as the pressure increases, the resistance decreases [6].

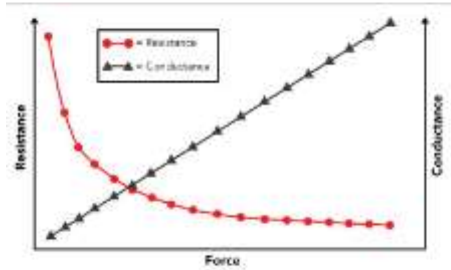

Fig.2 When force is applied to a force-sensing resistor, the conductance response as a function of force is linear.

$R \propto 1/F$ or F α 1/ R

The ARDUINO receives the data and sends a signal to the ESP 8266 WiFi module and the relay module if the data is more than the threshold value. The lights and fans are turned on by the relay. As illustrated in the block diagram in Fig.5, the Wifi module delivers data from the sensor, as well as whether the light or fan is on or off, to the cloud. The cloud serves as a monitoring system and a failsafe in the event that the sensor fails. The battery shield that will be linked to the ARDUINO will provide electricity. Two 9V rechargeable batteries will power the battery shield. The FSR will be powered by the ARDUINO because it just takes a few milliamps of current.

As indicated in Fig.1, the FSR will be positioned beneath a cushion so that the pressure exerted to it is evenly distributed. This technique works well with foam-filled chairs and couches. The foam is an excellent shock absorber. The average maximum pressure on an office chair was found to be 31 kPA in the research. This translates to 3.1 N/cm-2, which is well within our sensor's sensitivity range and will not harm it in any way [7],[8].

As needed, a threshold value for the analogue reading of the sensor is established. The sensor will not be used to determine the amount of pressure or force. We'll use it to create a threshold value that, if crossed, will signal that someone is sitting in the chair, causing the lights and fans to turn on. The ARDUINO code is written such that if the FSR's Analog value exceeds the threshold value, a HIGH signal is transmitted to the relay driver circuit, which turns on the electrical components (lights and fans). After laying the puddings, foams, and cushions on top, the sensor must be calibrated. Otherwise, the weight of the item must be provided in advance so that the sensor may be calibrated and dispatched as needed. According to the cutoff, if enough effort is exerted, the resistance will fall below the threshold, allowing the lights and fans to turn on.

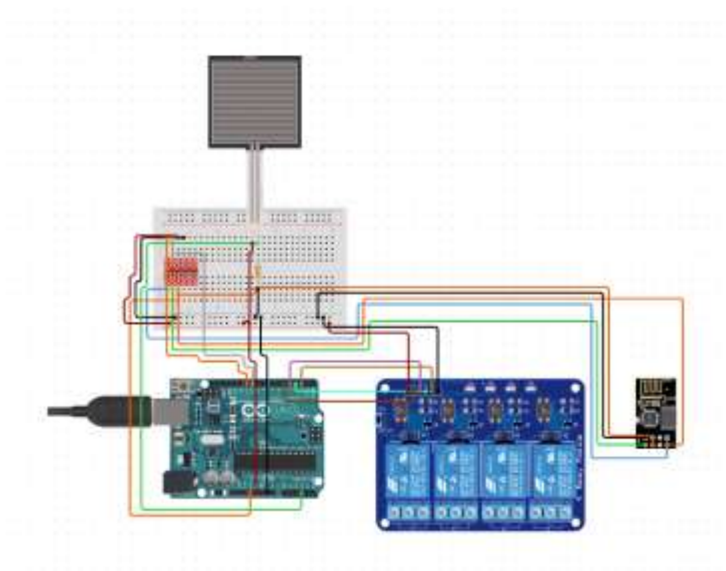

Fig.3. Circuit Diagram of the entire system using model FSR406.

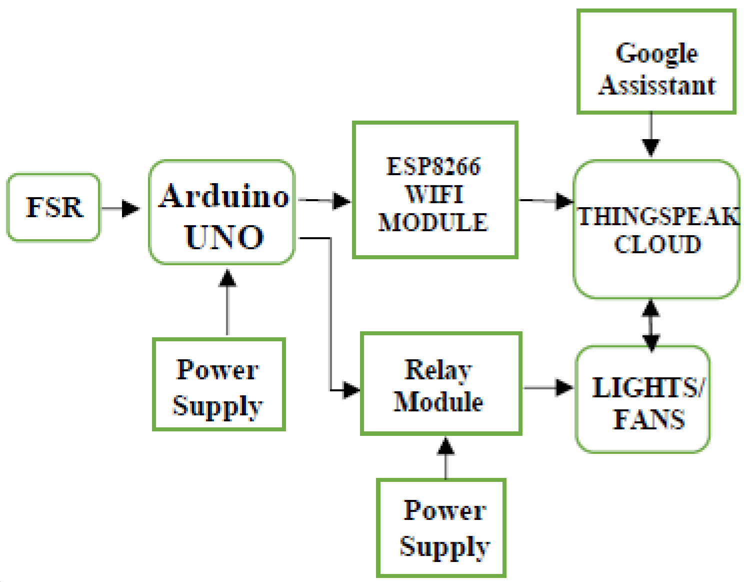

Fig.4. Block Diagram of entire system

IV. RESULTS

Figure 4 shows the circuit diagram. It depicts the connections between the various components. This circuit has been used to simulate anything. A 220V bulb is linked to a 5V dc relay. We also utilized a vibration motor with a variable resistance to simulate an FSR; the code used in ARDUINO is the same as that used in an FSR. The resistance functions as the internal resistance of an FSR, mocking the change in force sensed by an FSR when altered. Our relay was powered by a 9V battery. The simulations were carried out in Tinker CAD online under optimal conditions.

The FSR was linked to the ARDUINO UNO, which in turn was linked to the relay that powered the lamp. The relay was operated based on the signal received by the sensor. After monitoring the analogue reading of the vibration motor on increasing resistance, a threshold value of 500 was set. The resistance threshold has been set at 50.

The sensor's threshold value was set at 500, thus anytime the analogue reading increased over 500, the bulb turned out, and whenever it dropped below 500, it turned on. During the simulation, the observed FSR behavior matched the predicted values, with the result that when the resistance value is large, the bulb does not turn on, indicating that not enough force is applied to the sensor, and vice versa. It corresponds to the mathematical relationship of inverse proportionality between the applied force and the sensor resistance. The simulation results revealed that the targeted system outcome was favorable.

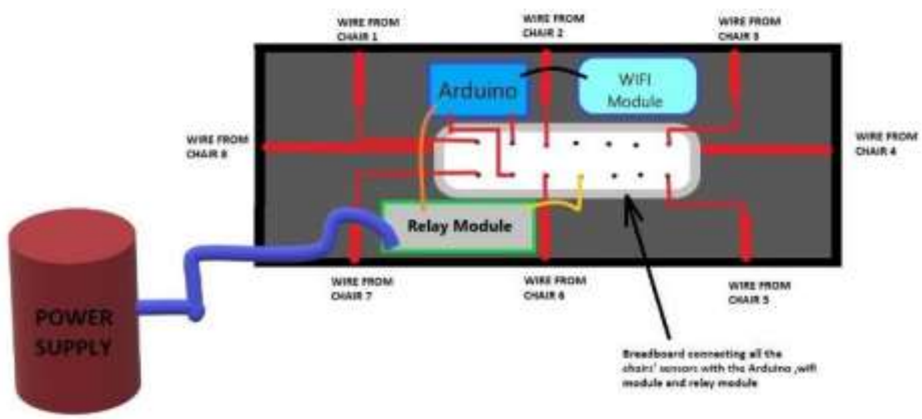

Fig.5. Schematic showing the wiring circuit

This system is designed to reduce the wastage of power and make the system more energy efficient. It is not the traditional way to detect human presence and controls electrical elements. It uses more modern, efficient, and unconventional technology. The sensor, FSR is designed and known to sense a wide range of forces. It is also very precise and accurate with its reading which makes it possible to distinguish a human over anything else. It requires very little power to operate and has a long shelf life. This system can be used to power the majority of the lights and fans which remain unnecessarily and adds to energy wastage.

The ARDUINO we used for our system can be substituted by microcontrollers to further improve energy efficiency. Not only 8-bit microcontrollers like the Atmega328p even 32-bit microcontrollers that run at 48MHz with similar memory are available for a lower cost. STM32 series stands as the strongest microcontroller to date. They can provide a greater advantage of controlling larger numbers of devices. However, using the microcontrollers add to the complexity of the system because it requires external hardware and additional compilers and boot loaders. PSoC (programmable system on a chip) can add further benefits and advantages over using a microcontroller. Its easy and versatile configuration is very useful for fast proto typing, we can also declare any pin as an analog or digital pin. It has the best analog support to date. In essence, it is a single chip, that does everything to take up multiple chips.

Currently, the works on load sensing seats equipped with many other technologies such as AI are mainly being used in the automobile industry [9]. Our designed system can be a new and more efficient technology to be used for such applications. Future works can include applications of class attendance monitoring system using load sensing seats similarly smart bus seat occupancy system. Both these systems will be a monitoring system associated with other technologies of how many passengers or students are present on the bus or class. This system can also be implemented in the recreation industry such as amusement parks where safety plays a major role. According to industry officials, 95% of amusement park accidents happen because visitors are often irresponsible and don't follow instructions strictly given to them or displayed at the entrance of a ride. The technology used in our system can be used with existing safety monitoring systems to build a safer environment. We use a cloud platform to connect all the components and sensors of the system. The working lights, fans, and sensors can be monitored through viewing the lamps and graphs in the cloud window as shown in Fig.5

The public sector has the maximum amount of power wastage in public waiting rooms, stations, offices, etc. Even at home, people tend to forget to switch off the fans and lights once they leave a room adding to power and energy wastage. Studies say 29 % of the energy of total energy consumed is used only for the lighting of which approximately 20% can be saved if lights are switched off properly. A study done at Boston University showed that if one light was turned off for one hour a day, they could save 7,33,475 kWh per year, which means 1,161,000 pounds of carbon dioxide. This can also reduce greenhouse gas emissions by 0.15 pounds per hour. In India, it was seen on average 5% of electricity consumed on every month is Vampire power.

Approximately the power wasted by fans was 2-6 Watts and lights were approximately 18 Watts [10]. This project mainly focuses on reducing the wastage of electricity and power.

V. CONCLUSION

We've presented a novel load detecting seat solution based on a smart seat design that controls the room's primary electrical components. Our strategy is distinct from others and yields favourable outcomes, as demonstrated in the simulation section. Here, we are developing a physical idea based on FSR pressure-force detection. We have created a method that will aid in energy conservation and improve overall quality of life.

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