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IR REMOTE CONTROLLED 16-CHANNEL SWITCH PANEL FOR HOME AUTOMATION

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Abstract— **This study introduced a unique approach to developing a low-budget and easy-to-use wireless switch panel for home automation. A TV remote has been employed to control the switch panel. A 16-channel, 5-volt relay module has been used as a controllable switch. A HX1838 capacitive IR sensor has been used to detect the upcoming IR infrared data, and an AVR-based ATMega8A microcontroller has been used to decode and process the sensor's data and also to control the relay module. An LED panel has been incorporated to indicate the state of the attached load. The whole setup has been powered by an on-board mobile charger. The proposed circuit seems to produce a relatively faster output response.**

Keywords: — *IR data transfer, capacitive IR sensor, home automation, AVR.*

I. INTRODUCTION

Home automation has significantly advanced over time, transitioning from basic standalone devices to complex interconnected systems that revolutionise how people engage with their living environments. Given the increase in energy consumption and population growth, there is a pressing need to conserve energy by all possible means. A primary contributor to energy waste is the inability to remotely access and control appliances [1]. This has led to today's advanced technologies that try to avoid additional burden and exert energy through their own automatic operations [2]. The term "automation" is broad and encompasses many elements; its history dates back as early as 1879, when two wires were joined to an electric battery with an alarm clock's hands to develop a battery and a light bulb circuit. Home automation entails the mechanisms characteristic of a building together with sensors and software. It includes the elemental and electrical means for monitoring and regulating household aspects, characteristics, operations, and facilities [3].

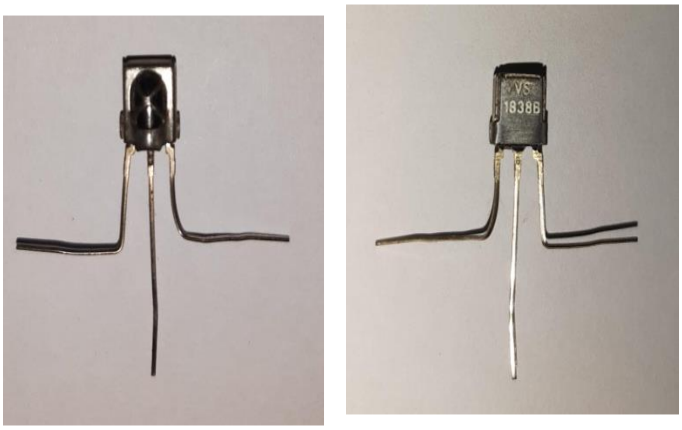
Various kinds of smart and semi-smart remote-controlled switch panels already exist. They have some advantages and various disadvantages, too.

Al-Kuwari et al. have made a smart embedded system using ESP8266 that will sense different variables inside the house and control the home appliances accordingly. The microcontroller allows real-time data sensing, processing, and uploading/downloading to and from the EmonCMS cloud server. But the system is pretty complex in nature, expensive, and not that user-friendly [4]. S. P. Makhanya et al. and Vivek et al. have made an Android app-interfaced model. Through a Wi-Fi IP address, the Android app connects with the switch panel. Using this, we can control home appliances from anywhere at any time. But the main disadvantage of this model is that the user has to have a stable internet connection. It could be very difficult to get a stable connection in remote areas; otherwise, it will face some delay or connection failure [5],[6].Abubakar et al. and Pramanik et al. have made a similar kind of model implementing a GSM sim-card model with SMS interfaces. The range of this model is very high, but the GSM module has significantly low accuracy. Because of the SMS system, the system will face a delay during operation, and the channel handling is low [7, 8].

This study presents a low-budget, high-performance semi-automatic model using IR data transmission. The model uses a random TV remote as the transmitter and a HX1838 IR sensor as the data receiver. An AVR-based ATMega8A microcontroller is used for processing and controlling the relay module. A 16-channel relay module is connected directly to the microcontroller's GPIO pins. The setup is powered by an old mobile charger. This setup results in good range and minimal delay to toggle the appliances. The setup can control multiple loads at the same time.

II. METHODOLOGY

The working principle of the present model depends on the infrared data being transferred via a TV remote, receiving the data using an HX1838 capacitive IR receiver [9] and processing the data using an AVR-based ATmega8A microcontroller.



(a) (b)

Fig. 1: HX1838 (a) front view, (b) back view

A random TV remote has been chosen to be used as an IR data transmitter. Every remote has a specific embedded IC into it, which generates a specific and unique 16-bit binary code (high & low) for individual buttons. When a button is pushed, the IC generates the data and transmits it using an IR LED in such a way that when the bit is high, the LED starts glowing, and when the bit is low, the LED stops glowing.

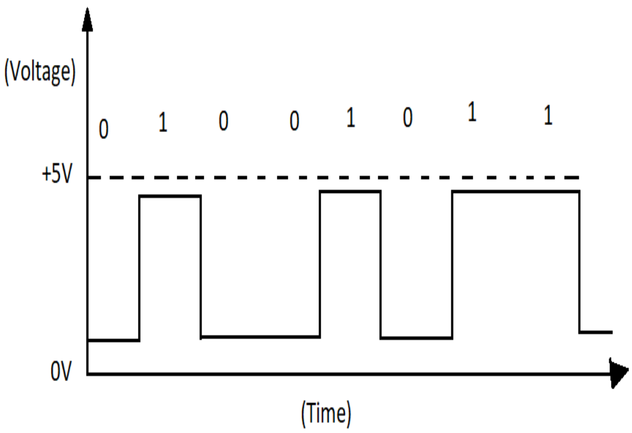


Fig.2: Transmitted or received signal flow diagram

This data is then received by an HX1838 IR receiver. HX1838 is a semiconductor-based capacitor with three legs (vcc, ground, and signal). The capacitance of the sensor depends on the specific spectrum of infrared light (the same spectrum used by the TV remote). When the sensor senses the IR light, its capacitance changes, and the capacitance is then converted into an analog signal.

A temporary setup consisting of an Arduino and an HX1838 has been developed to decode the specific codes of the switches. Then each code has been allocated in such a way that if it is pressed, the microcontroller toggles and holds the state of the load.

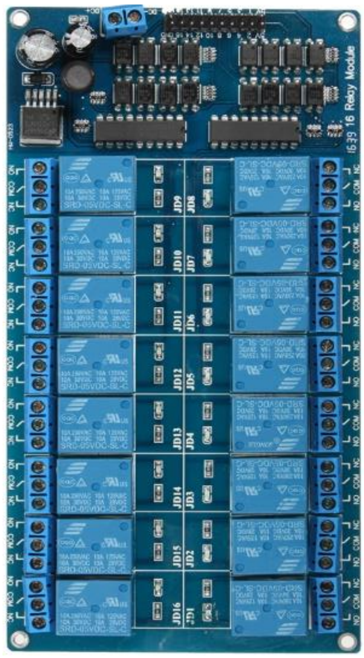


Fig.3: Relay module

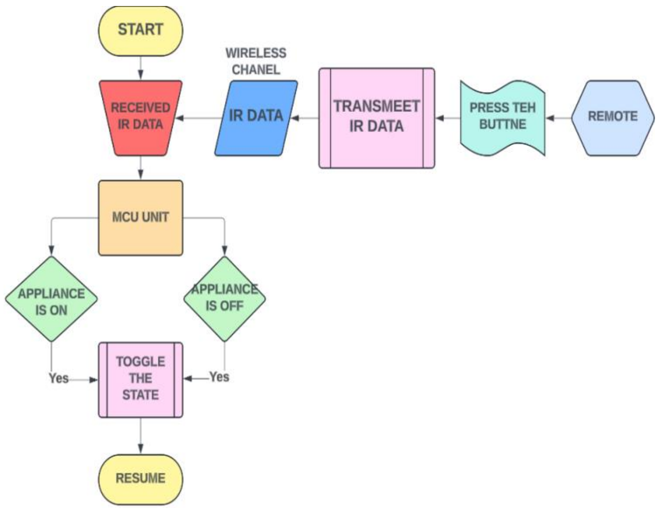


Fig.3: Working flow chart

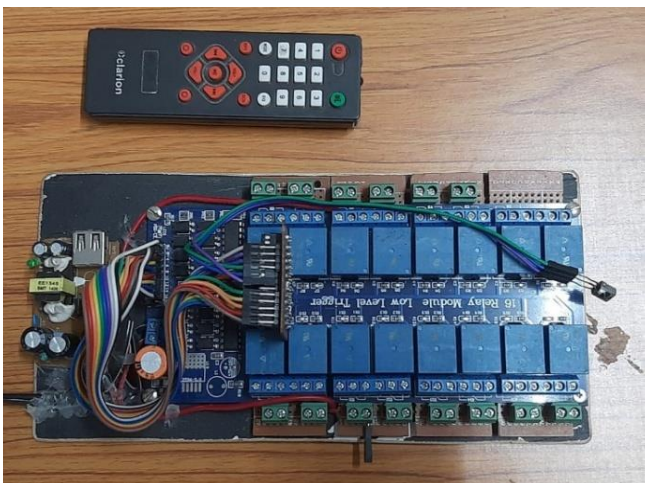


Fig.4: Setup image

III. RESULT AND ANALYSIS

Table.1 Observation table

SL. No.	Switch No.	Switch code(HEX)	Relay channel No.	Output LED status
1	S0	1621	R1	ON OFF
2	S1	1622	R2	ON OFF
3	S2	1623	R3	ON OFF
4	S3	1624	R4	ON OFF
5	S4	1625	R5	ON OFF
6	S5	1626	R6	ON OFF
7	S6	1627	R7	ON OFF
8	S7	1628	R8	ON OFF
9	S8	1629	R9	ON OFF
10	S9	1630	R10	ON OFF
11	R	1513	R11	ON OFF
12	L	1514	R12	ON OFF
13	U	3251	R13	ON OFF
14	D	3252	R14	ON OFF
15	B	3253	R15	ON OFF
16	EQ	3254	R16	ON OFF
17	M	1620	ALL	ON OFF

Table 1 summaries the operation of the proposed system. For example, if switch S0 is pressed, switch code 1621 will be generated, which will trigger relay channel no. 1 (R1) The output load will be either toggled to an ON state or an OFF state based on the preceding state and as per the requirement of the user, i.e., one can control the output devices from the IR remote via the 16-channel switch panel. The other outputs will remain in the previous state as switch S0 is not triggering other relay channels. A special switch M has been employed to control the entire relay channels simultaneously, i.e., either all of them will be driven to the ON state or the OFF state. Individual control is not possible in this case. Another important aspect to be highlighted is that multiple loads can be driven from multiple channels simultaneously.

IV. CONCLUSION

This work presents a new, low-budget, and easy-to-use wireless switch panel for home automation. The whole set-up consists of a switch panel that has been controlled by a TV remote. A HX1838 capacitive IR sensor has been integrated for the detection of the upcoming IR infrared data. An ATMega8A microcontroller serves three purposes: decoding, processing the sensor's data, and controlling the relay section. A 16-channel, 5-volt relay module has been introduced as a controllable switch. An LED panel has been incorporated to indicate the state of the connected load. The whole setup produces relatively faster output transitions, i.e., the proposed circuit offers a faster response time, which will be estimated for comparative analysis in future studies.

V. REFFRENCESS

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