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IoT based Interactive Home Automation with SMS and Email Alert System

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Abstract: ***Home Automation Systems contributes a major part in today's day to day life making it comfortable and luxurious by improving the quality of life. We are in the era of Internet of things where there is never ending growth of internet application in home automation because of which it is getting more popular due to its countless advantages. The proposed paper depicts the 'Full Home Control', the aim of the Home Automation Systems in near future. Due to low cost and simplicity in communication through Smartphone and tablet over the internet the Popularity of Home automation is being gaining growth. This paper proposes a Low cost Home Automation System using Raspberry Pi3 as a processor and Arduino UNO to control and monitor home appliances remotely using mobile phone or tablet. Raspberry Pi3 monitors and controls security system, water, fire and LPG systems and Arduino UNO is used for controlling and monitoring of lights, fan, temperature and humidity. GSM is used to communicate home appliances such as light, fan, gas monitoring, water monitoring, fire alert system and security system via Short Message Service (SMS) text messages. The proposed work makes use of the communication protocol of GSM and Wi-Fi, allowing the owner to control the HAS away from the home/residential area using the respective frequency bandwidths. Raspberry Pi 3 is used to detect intruder via email sent to the authorized person which consists of image of the intruder and the access can be granted or denied by using the concept if IoT. The proposed system depicts the use of simple technologies that can be applied in smart home with a cheap and flexible monitoring and controlling system based smart home.***

Keywords: Raspberry pi 3, Arduino UNO, Smoke sensor, Camera, IR sensor, pH sensor, DHT11 sensor, LDR sensor, Buzzer, AC Pump, GSM Module, LCD Display, Level sensor, Gas sensor, Fire sensor, HAS (Home Automation System)

I. INTRODUCTION

Era of Internet of Things has revolutionized our life by many innovative technologies that are used to design a system which can be controlled and monitored easily by using handheld devices even when the user is away from the home. Smart home is defined as an advanced intelligent environment which consists of technologies that makes the electronic devices to anticipate and respond according to the requirements of the home residents. While designing a smart home one must consider many aspects. These aspects can be categorized into three categories, these are as follows: firstly, to provide comfort in the zone of elder care, childcare and healthcare; secondly, improvement in terms of security by enabling alert system in order to protect the residents when a suspicious activity has been noticed and thirdly, to reduce the energy consumption and finally provision to multimedia entertainment. By keeping these aspects in mind a flexible remote controlling system will be designed for networking smart home appliances that can be accessible by multi-entry points such as personal computers, tablets, smart phones etc as shown in Fig.1. The proposed project depicts a low cost and efficient implementation of IoT application used for monitoring and controlling the home appliances via GSM and World Wide Web. In this proposed project the implemented Home Automation system makes used of handheld portable devices as user interface. The communication with the network of smart home appliances is done by the means of internet gateway, which is by means of low power consumption protocols like Wi-Fi, Zigbee etc. The proposed has been implemented into two parts; the first part depicts Arduino UNO as the processor and the second part, Raspberry Pi 3 as the main processing unit. This projects implements GSM and Wi-Fi for controlling home appliances via smart phone as communication protocols. Arduino UNO monitors lights and fans, sends an alert message if lights are on and fire is detected. Raspberry Pi3 is implemented as server and it monitors and controls security system, water system, and LPG gas and fire safety.

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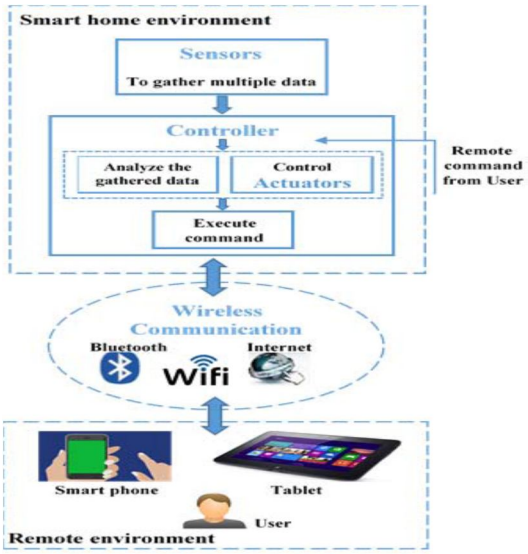


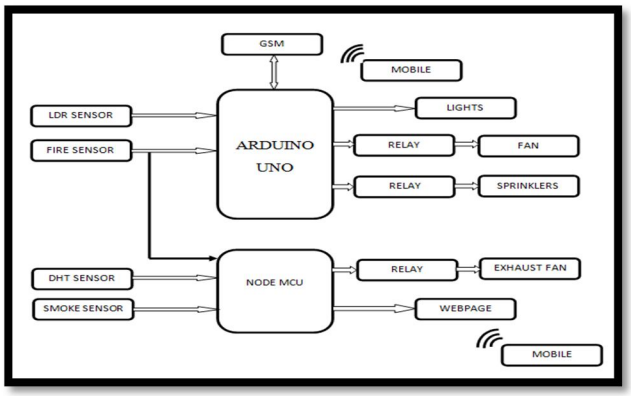
Fig. 1 An illustration of working of Home Automation System

II. LITERATURE SURVEY

Since the advent of IoT there has been many efforts to implement smart homes in very less expensive, easy to handle and secured manners one such implementation is proposed by Dr. R N Kulkarni where an Arduino is used as processor to control lights and fans through smart phone over Wi-Fi[5]. In paper "IoT Based Home Security System Using Raspberry Pi with Email and Voice Alert" R. Rani proposed a raspberry pi based security system which alerts the owner if there is any intrusion through email [4]. Alan Macker proposed a system foe LPG gas monitoring where automatic booking of cylinder is done when it is empty and if gas leakage occurs an alert message is sent [3]. Manish Kumar Jha proposed a system called smart water monitoring system (SWMS) where through various sensors water quality and quantity is monitored regularly [2]. Lastly a system proposed by Waheb A. Jabbar consists of Arduino ATmega with Wi-Fi as communication protocol to control lights and fans through an app called virtuino [1].

III. PROPOSED DESIGN METHODOLOGY

The proposed work in this paper implements the following hardware components: Raspberry Pi3, Arduino UNO, Node MCU, GSM, PIR sensor, LDR Sensor, DHT 11 sensor, smoke sensor, fire sensor, level sensor, pH meter, DC motor, AC pump, relays. Here the proposed system can be categorized in two parts. The first part consists of ARDUINO UNO as its controller as depicted in the Fig 2. Where lights and fans are switched on /off by sending an SMS and there will be updating of the temperature and humidity continuously along with the input from fire sensor the information is updated on webpage via Node MCU. And if there is fire then exhaust fans and sprinklers are turned on. The proposed project enhances the facet of protection from accidents that can occur due to fire and enhances the capability of sleuthing the smoke in order to prevent a greater loss and an alerting text message is sent to the owner. Here GSM and Wi-Fi are used as communication protocols.



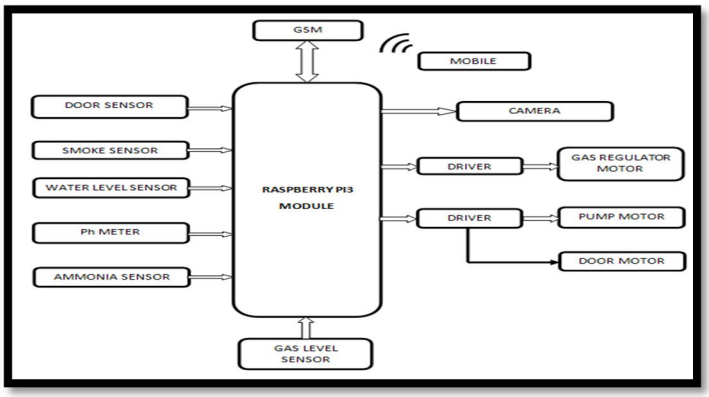


Fig.2 Block Diagram of Proposed system with ARDUINO UNO as Processing unit. Fig.3 Block Diagram of Proposed system with RASPBERRY PI 3 as processing unit.

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The second part of the proposed system consists of Raspberry Pi3 as the processor as depicted on Fig 3. This paper proposes a framework that monitors and controls the security system, water monitoring and gas monitoring. In this proposed system if an Intruder or unauthorized persons enter into our zone the PIR Sensor detects the activity and an image is captured by the camera which is attached to the Raspberry Pi and is sent to the owner of the house via g-mail along with a real time SMS. After the real time SMS alert the security system turns on the buzzer.

The captured image will be sent to the authorized person by the usage of inbuilt Wi-Fi module in the Raspberry Pi board. Again the owner can grant access or deny the access of the intruder through g-mail. This paper depicts a system where the booking of LPG cylinder is made easier without any human intercession. The weight of the cylinder is constantly monitored and when the cylinder is empty a real time message is sent to the gas agent.

Along with the automated booking we have implemented a process to ensure the safety and well being of the client by constantly monitoring of LPG spillage. If there occurs leakage of gas then the gas regulator automatically turns off and a real time message is sent to the owner via Arduino unit. Another added feature of this proposed system is water quality and water billing based on the consumption of the water. The server will here is interfaced with relay hardware circuits which controls the appliances running at home. The communication with server permits the user to pick out the acceptable device. The server communicates with the corresponding relays.

IV. HARDWARE IMPLEMENTATION

1) *Power Supply:* The proposed work requires AC and DC power supply as the DC supply is used for Arduino and raspberry pi where as AC supply is used for submersible pump. Here 12V are required but AC is 230V hence, a step-down transformer, bridge rectifier and filter are used to convert AC to DC to obtain the required power.
2) *Arduino UNO:* The Arduino Uno R3 is a microcontroller board based on ATmega328. It consists of 14 digital I/O pins, 6 analog pin, a 16 MHz crystal oscillator, a USB connection, a power jack and a reset button.
3) *Raspberry Pi 3:* The raspberry pi board comprises a program memory (RAM), processor and graphics chip, CPU, GPU, Ethernet port, GPIO pins, Xbee socket, UART, power source connector. And various interfaces for other external devices. It also requires mass storage, for that we use an SD flash memory card
4) *GSM:* Global system for mobile communication is one of the most popular standards for mobile technology system. It is one of the wireless networks which have low power & low cost communication devices.
5) *LCD (Liquid crystal display):* In our proposed system 16*2 LCD is a display unit. The material used in LCD combines the properties of both liquids & crystal. It has two registers namely command register & data register.
6) *Node MCU (Wi-Fi Module):* It is used to provide the internet connection. It consists of ESP-8266 Wi-Fi networking solution & also capable of running self constrained applications.
7) *Buzzer:* The buzzer is an output device when an unauthorized user wants to access the RFID cards buzzer beeps the sound.
8) *AC Motor:* It is a submersible motor pump can lift water up to 0.7meters & it is easy to install & handle. It consumes low electricity & it is compact in size.
9) *IR sensor:* Infrared Obstacle Sensor Module has built in IR transmitter and IR receiver that sends out IR energy and looks for reflected IR energy to detect presence of any obstacle in front of the sensor module. The module has on board potentiometer that lets user adjust detection range. The sensor has very good and stable response even in ambient light or in complete darkness.
10) *MQ2 Sensor*: The MQ-2 is a flammable gas and smoke sensor detects the concentrations of combustible gas in the air and outputs its reading as an analog voltage. The sensor can measure concentrations of flammable gas of 300 to 10,000 ppm. The MQ-2 gas sensor is sensitive to LPG, i-butane, propane, methane, alcohol, Hydrogen and smoke.
11) *DHT 11 Sensor:* The DHT11 is a commonly used Temperature and humidity sensor**.** The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.
12) *Camera:* A webcam is a video camera that feeds or streams an image or video in real time to or through a computer to a computer network, such as the Internet. Webcams are typically small cameras that sit on a desk, attach to a user's monitor, or are built into the hardware. Webcams can be used during a video chat session involving two or more people, with conversations that include live audio and video.

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V. EXPERIMENTAL SETUP & RESULTS

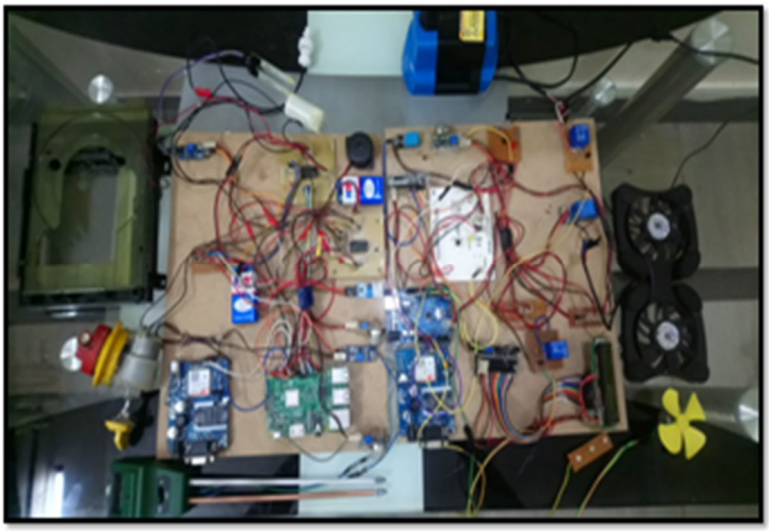


Fig 4. Experimental Setup of Smart Home Automation System.

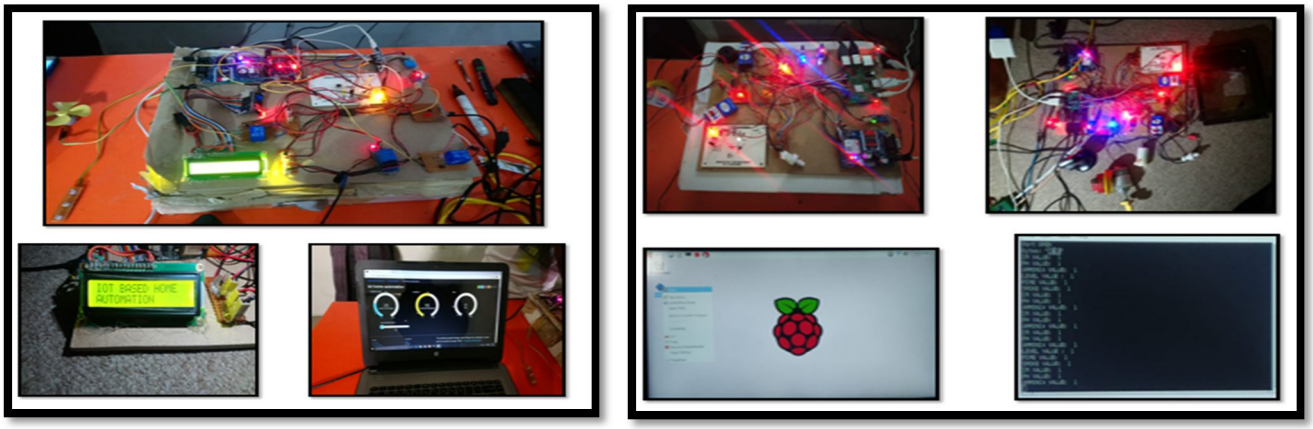


Fig 5.(A) Monitoring Part Of Smart Home Automation System With Arduino As Process (B) Monitoring And Controlling Part Of Smart Home Automation System With Raspberry Pi 3 As Processing Unit.

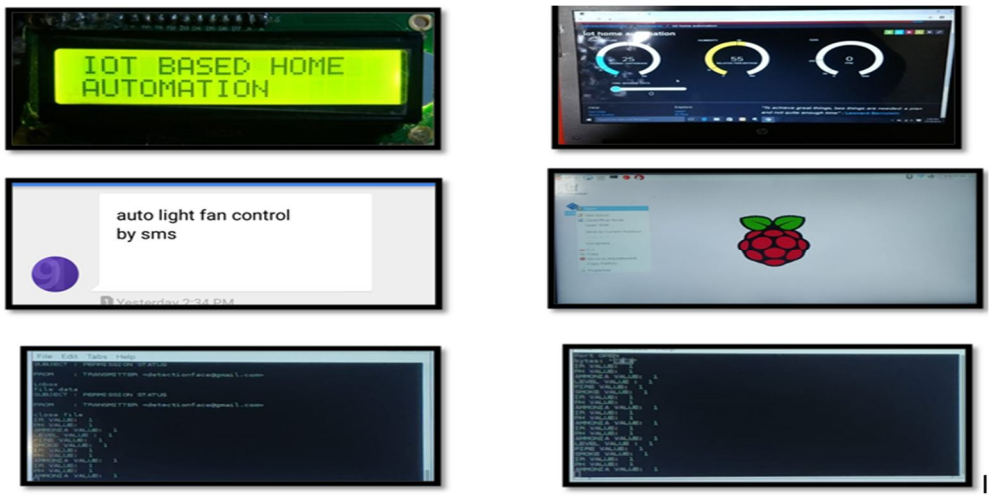


Fig 6. Initialization of Arduino and Raspberry Pi

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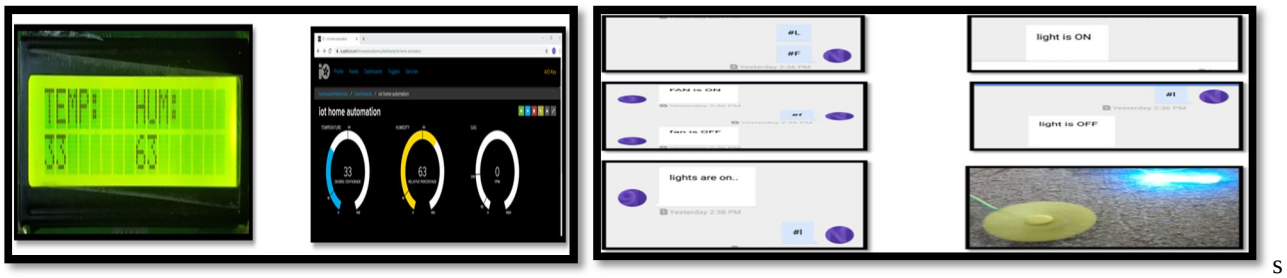


Fig 7. (a) Temperature and Humidity display on LCD and webserver (b) SMS control of light and fan through Arduino.



Fig 8. (a) GAS detection (b) Fire detection.



Fig. 9. (a) Automatic GAS booking. (b) water monitoring and billing

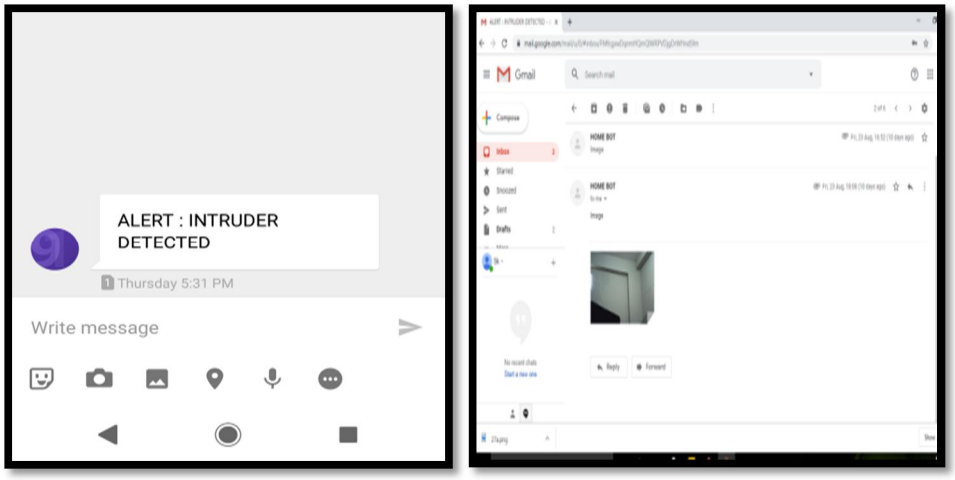


Fig 10. (a) Intruder Alert message (b) EMAIL sent to the owner.

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VI. RESULTS

From the proposed system we can take the results that this system reduces the energy consumption and prevents mishaps and takes precautionary measures immediately. The proposed system provides the use of GSM and Wi-Fi in order to communicate with the various electronic appliances. Here the light, fan and fire safety is provided through the Arduino UNO Where as security, LPG monitoring and billing and water quality and billing is carried out by raspberry pi. In security system the owner is alerted via SMS as well as the image is captured and sent to the used. Based on the permission either the intruder is granted with access or denied.
Nest is LPG monitoring where automatic of the refill is filed and if there is any spillage of LPG the regulator turns off and an alert text is sent. Similarly with water monitoring an alert message is sent when water is impure. Here we are using different sensors that alert the users if there are any accidents.

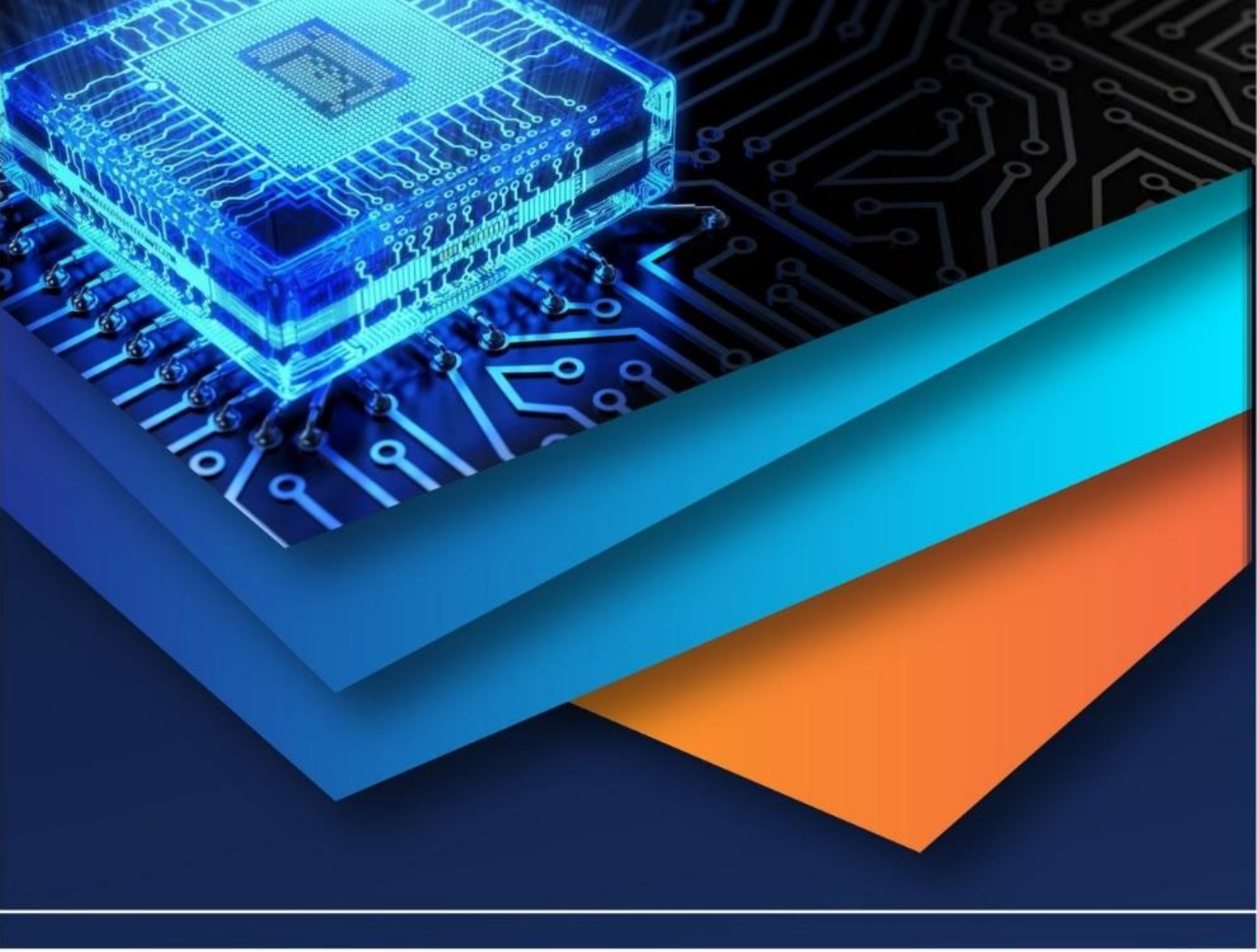
VII. CONCLUSION

By using IoT various applications can be implemented by monitoring and controlling various household devices and can also be applied in the field of Industrial management and in hospitals etc. By using two processors here we are dividing the workload. The monitoring and controlling of lights, fan and temperature helps in less consumption of energy. Whereas on the other hand by implementing raspberry pi we overcome some issues and have a solution for LPG booking and spillage, water quality and quantity monitoring thus saving water and alerting user from hazardous water conditions and finally increasing the security and alerting the owner if there is an intruder.

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