JEDIC

Journal of Ethics and Diversity in International Communication

| e-ISSN: 2792-4017 | www.openaccessjournals.eu | Volume: 2 Issue: 10

Utilizing the Internet of Things for Intelligent Home Automation

C. R. Rathish
Associate Professor, Department of Computer Engineering, New Horizon College of Engineering, Bengaluru, India

R. Regin
Assistant Professor, Department of Computer Science and Engineering, SRM Institute of Science and Technology, Ramapuram, Chennai, India

S. Suman Rajest
Professor, Bharath Institute of Higher Education and Research, Chennai, Tamil Nadu, India

Shynu T
Master of Engineering, Department of Biomedical Engineering, Agni College of Technology, Chennai, Tamil Nadu, India

Steffi. R
Assistant Professor, Department of Electronics and Communication, Vins Christian College of Engineering, Tamil Nadu, India

Abstract: Internet of Things and Data Science are the most popular and valuable technologies in the corporate and commercial fields. In our project, we created a Smart Home Automation System using Internet of Things (IOT) Technology. The Internet of Things allows everyday things to communicate and receive data via internet-connected computing devices. In this project, the first module controls fan speed automatically based on room temperature. Our second module automatically adjusts light brightness based on ambient light. Third module monitors LPG gas leakage and informs user to avoid serious incidents. Fourth module uses float sensor to measure water level. These modules have sensors that generate data at intervals. Using a web app, we analyse these data values. The web app tracks live data. The report will assist us understand module energy consumption. It helps handle electricity efficiently.

Keywords: Smart Home Automation, Internet of Things, LDR sensor, Printed Circuit Board, Bluetooth Module

Introduction:

New sensors, wireless technology, and mobile phones are driving the expansion of the Internet of Things (IOT). The IOT's commercial ethics lay in analytics, not physical inventions [1]. Project metrics are consistent. We started with two IOT-based modules. The first module adjusts light brightness based on outside brightness [2-5]. The module employs an LDR sensor to measure outdoor brightness and microcontroller code to adjust light intensity. In the second module, we created an automatic fan speed-controlling system that adjusts a DC Fan's speed based on room temperature [6-13]. It has a Dht11 temperature sensor for controlling fan speed. The microprocessor controls the DC fan's speed. Both PCB modules (Printed Circuit Board). We constructed a Web app to retrieve sensor values using WIFI Module after implementing both

modules [14-18]. The online app displays power, voltage, current, temperature, etc. interface values [19-22]. Web app generates a sheet with field values. This helps manage electricity use in homes, industries, etc.

Existing system uses GSM and Bluetooth modules. Bluetooth and Wi-Fi technology have allowed devices to connect [23-26]. Using a WIFI shield as an Arduino Micro web server eliminates the need for wired connections, lowering cost and allowing it to run independently. The Wi-Fi shield needs a wireless router or hotspot as the Arduino's gateway to the internet [27-33]. To control home appliances remotely, an internet-based home automation system is built. This device has a Dht11 Temperature sensor, PCB, L298N Driver, and DC fan. We connected an ATMEGA16 microcontroller and LCD to the PCB. We connected the L298N driver's PCB input and DC fan output [34]. The temperature sensor measures the surrounding temperature and regulates fan speed based on microcontroller code [35-41]. LCD displays the sensor's temperature in Celsius. We've coded four levels so the fan may vary its speed based on the sensor's temperature. It adjusts the fan's speed as needed [42]. DC fan DC fans are utilised to meet airflow and static pressure requirements. DC fans use less energy [43-49].

Automatic Light Brightness Controlling

LED bulbs, LDR sensors, PCB, and an L298N driver are used in this unit. This unit uses our first PCB board (i.e. the Fan unit) [50]. Similar to our fan module. LDR sensor senses outdoor brightness and adjusts LED bulb brightness [51-57]. LCD displays light intensity %. If outside brightness increases, light intensity drops, and if outside darkness increases, light intensity increases [58-65]. LDR sensor and microcontroller coding produce this. These modules change light brightness for humans. Light Dependent Resistor Sensor The component is passive. It's a resistor with light-dependent resistance [66-71]. It's employed in electronic circuits, clocks, street lights, etc.

Automatic Gas leakage detector system

This gadget detects LPG with semiconductor sensors. MQ2 sensor is utilised. When the target flammable gas is present, sensor conductivity rises. The MQ2 gas sensor detects Propane, Butane, LPG, and Natural gas. The sensor detects flammable gases, especially methane. Low-cost and versatile [72-78]. Suppose the system detects an unsafe gas level. In that event, it will trigger the alarm, including the buzzer, to inform the home's users and prompt them to act. Gas odour in the residence indicates a leak [79]. Carbon monoxide leaks can cause specific physical problems. This document detects leaks [80].

Water level monitoring system

The tank's float switch measures water level [81-88]. It has two wires. The float switch's D4 (GPIO2) and ground wires are linked. NodeMCU reads float sensor. "HIGH" signifies the tank is full; "LOW" means it's empty [89-93]. D1pin (GPIO5) is connected to the water pump's switch. The switch turns ON when the water level is low and OFF when it's high [94].

Live Data Tracking Using Web Application

Multiple approaches exist for user and system interaction. Use an app. Even with no programming skills, it's easy to construct a mobile or web-based data app. The user can also send SMS commands to the microcontroller using mobile GSM. This circuit requires a GSM module. Email can also be used [95-99].

Proposed System Block Diagram Description

Home automation is a network of sensors, hardware, and electronics. WIFI lets us handle them from our phone or tablet at home or far away [100-107]. Home automation includes three parts: Sensors, controllers, actuators. Sensors measure lighting, temperature, and motion. Home automation systems adapt settings to our tastes [108]. Controllers are PCs, tablets, or cellphones that send and receive signals concerning home automation. Actuators control a home automation's real mechanism or function [109-115]. They're actuated by remote control. This project adjusts the fan speed based on the temperature, allowing the user to customise it. Reduces fan remote use. In another module, we've replaced traditional bulbs with LEDs to offer automatic brightness adjustment. The LED bulb's brightness adjusts to outside light. LDR gives clever automatic light control. Implementing both modules and data analytics on their outputs can minimise energy and maintenance expenses [116-121]. Web applications can display module info. Suppose the system detects an unsafe gas level. In that event, it will trigger the alarm, including the buzzer, to inform the home's users and prompt them to act. Gas odour in the residence indicates a leak. The tank's float switch measures water level [122-125]. Arduino has powered countless of projects, from common objects to scientific apparatus [126]. Arduino was created at the Ivrea Interaction Design Institute as a quick prototyping tool for non-technical students. As soon as it reached a wider audience, the Arduino board changed to adapt to new needs and problems, offering devices for IOT, wearable, 3D printing, and embedded contexts [127-130]. Arduino boards are open-source, allowing users to construct and customise them. Open-source software grows through global user contributions [131].

Atmega 328p – Microcontroller

Microchip's ATMEGA328P controller is high-performance and low-power. ATMEGA328P is an AVR RISC microcontroller. The ARDUINO board uses the most common AVR controller. ATMEGA328P is the most popular controller due to its price and features. This controller's characteristics enable the development of ARDUINO boards. ATMEGA328 works like other controllers. A programme is needed. The controller runs our software as needed. Controller does nothing without programming. First, we must programme the controller by writing a programme file to the ATMEGA328P FLASH memory. After dumping programme code, the controller executes it and responds.

Power Supply

USB or external power can power the Arduino Uno. Automatically chooses power source. An AC-to-DC adapter (wall-wart) or a battery can provide external (non-USB) power. A 2.1mm centre-positive plug connects the adapter to the board's power connector. POWER connection Gnd and Vin pin headers accept battery leads. The board runs on 6 to 20 volts. If less than 7V is given to the 5V pin, the board may be unstable. Using more than 12V may destroy the board's voltage regulator. 7-12 volts is preferable.

Memory

Atmega328 has 32 KB of flash memory (0.5 KB for boot loader), 2 KB of SRAM, and 1 KB of EEPROM (which can be read and written with the EEPROM library). Separate bytes can be read and written in its data space. EEPROM contains 100,000 write/erase cycles. The I/O area contains all ATmega48P/88P/168P/328P I/Os and peripherals. LD/LDS/LDD and ST/STS/STD can access all I/O locations to transfer data between the 32 working registers and I/O space. I/O Registers 0x00 - 0x1F are bit-accessible utilising SBI and CBI. SBIS and SBIC instructions verify single bits

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Journal of Ethics and Diversity in International Communication
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in these registers. Instructions are in the manual. I/O addresses 0x00 - 0x3F must be utilised for IN and OUT.

General Purpose Input and Output

Using pin Mode (), digital Write (), and digital Read (), each of the Uno's 14 digital pins can be utilised as an input or output. 5 volts. Each pin may deliver or receive 40 mA and contains a 20-50 KOhm pull-up resistor (disconnected by default).

Arduino IDE

IDE integrates an editor, linker, and compiler to let developers produce Firmware for Innovative Projects. Arduino IDE is important for open-source prototyping and library access. This beginner-friendly tool supports embedded C, Luna, etc. Arduino has powered countless of projects, from common objects to scientific apparatus. Supports Arduino Uno, Nano, Mega, etc. As soon as Arduino reached a wider audience, it changed to adapt to new requirements and difficulties, offering devices for IoT, wearables, 3D printing, and embedded environments.

Power Supply:

One circuit can provide 12V and 5V DC power. Two ICs, 7812 and 7805, provide the necessary voltages. The transformer steps down the AC mains voltage, which is rectified and filtered by the bridge and capacitor. The 7812 regulates it to 12V DC. 7805 regulates IC1's output to 5V DC. This produces 12V and 5V DC. Fig. 1 shows the power supply block and circuit schematic.

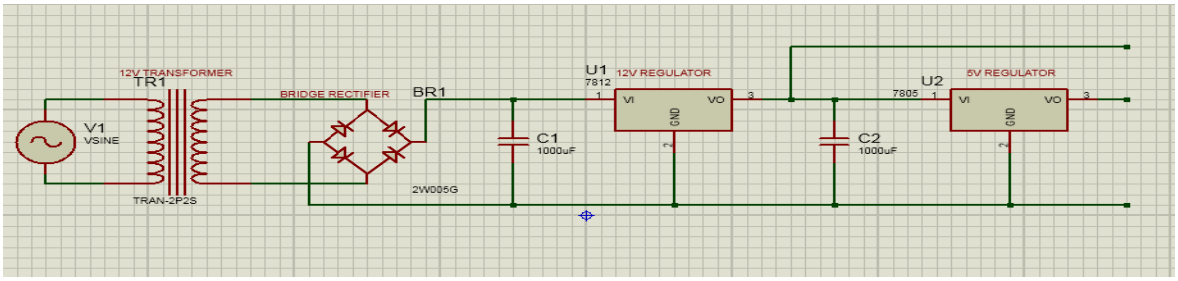

Fig. 1: Circuit diagram

A step-down transformer reduces 230V AC to 12V AC. Transformer output is sinusoidal AC, which is rectified to DC. The filter circuit uses this output to eliminate AC ripples and pass DC. 7812 regulators convert 12V DC to AC. 7805 regulators convert 5V DC.

DHT11 Sensor

This DHT11 Temperature and Humidity Sensor has a calibrated digital signal output. Integrated 8-bit microcontroller. Its technology is reliable and stable. This sensor has a resistive element and a wet NTC sensor. It's good quality, quick, and anti-interference. Each DHT11 sensor's humidity chamber is highly accurate. Internal sensors detect signals and record calibration coefficients in the OTP programme memory. The single-wire serial interface system is simplified. Small size, low power, and 20-meter signal transmission distance enable demanding applications. 4-pin single-row pin package. User-requested connections and packages are available. DHT11 sensor reads temperature and humidity. DHT11's analogue output is connected to Arduino A0's analogue input. DHT11 has three pins. The dht11 sensor also calculates dew point, heat index, etc. Dew point is the temperature at which air freezes into water droplets, and heat index is the environmental heat felt by the skin. High humidity requires this. Despite a decreased temperature, the body feels heated. High humidity causes this. The air's humidity level. High humidity causes sweating.

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Float Sensor

Most float switches open or close a circuit as tank liquid rises or falls. Two electrical contacts will be enclosed in glass with a reed switch. The two leads will be close but not touching. The glass-lead housing will be installed in the tank to trigger the response. Magnetic floats float in liquid. As the tank level rises or falls, the float approaches the leads. When the float is close, the magnetised leads join to complete the circuit. When the liquid level fluctuates, the float and electrical contacts separate, breaking the circuit.

How A Floating Switch Works

Float switches detect tank liquid levels. Float switches can be used for many different things. They can be set to activate or disengage a response when the liquid level rises or lowers to a certain level. Multistage float switches can provide feedback or perform different operations when tank liquid rises or falls (fig.2).

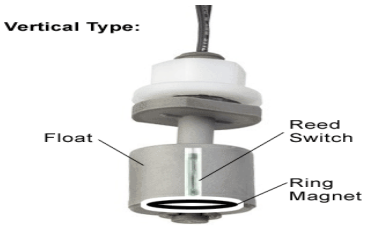

Fig. 2: Float Sensor

LDR SENSOR

Light-dependent or photo-resistors are utilised as photo-detectors in LED circuits. In darkness, terminal resistance can reach 1 M. High brightness reduces resistance to a few hundred ohms (fig.3).

Fig. 3: LDR Sensor

LCD Display

Many hobbyists use displays. LCDs are their most advanced display device. Once you interface it, it'll be your easiest and most reliable output device. Debuggers aren't always usable for microcontroller-based projects. LCDs can test outputs. LCD accepts data-and-control signals. LCD module reads signals from RS pin. Pulling the R/W pin high reads LCD data. LCD reads and executes data at the falling edge of the E pin pulse; same for transmission. LCD takes 39-43S to place a character or execute a command (except for cleaning the display), and 1.53ms to 1.64ms to seek the cursor home. Sending data before this interval may cause some devices to fail to read data or execute current data. Some devices speed up by temporarily storing incoming data (fig.4).

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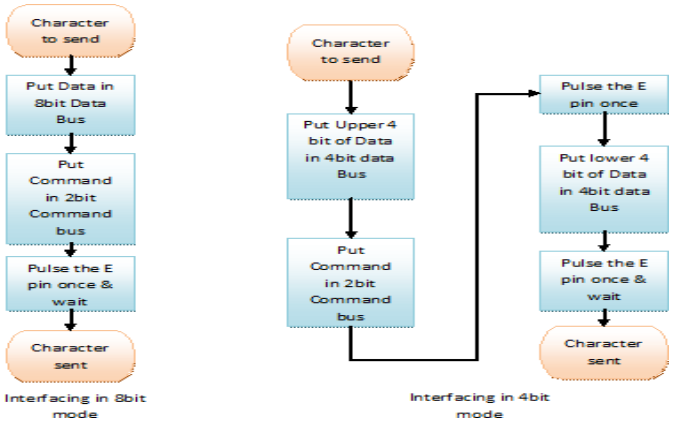

Fig. 4: Flow chart of interfacing LCD

LCDs use DDRAM and CGRAM. DDRAM stores the ASCII chart position and character. DDRAM stores each LCD position. LCD controller reads DDRAM and displays data on LCD. CGRAM permits user-defined characters. First 16 ASCII characters are reserved for users. After CGRAM is set up to display characters, users can display their own on the LCD panel.

Operations of Relay

A tiny DC current energises the relay coil. The armature is attracted to the NO pin. When the coil current stops, the armature returns to its usual position, connecting COM to NC (Normally Connected). Relay operation is fundamental (fig.5)

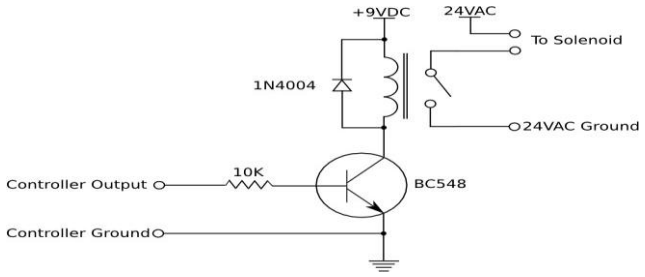

Fig. 5: Circuit Diagram for Relay Driver

DC Water Pump

When DC runs through a relay coil, it energises. So the armature is drawn to the NO pin. When the coil current ends, the armature returns to normal, connecting the COM pin to the NC (Normally Connected) pin. All relays work the same (fig.5)

Fig. 6: DC Pump

BUZZER

Buzzers and beepers are mechanical, electromechanical, or piezoelectric audio signalling devices. Buzzers and beepers are used as alarms, timers, and user input confirmations (mouse click, keystroke). Buzzers are integrated structures of electronic transducers and DC power supplies used

in computers, printers, copiers, alarms, electronic toys, automobile electronics, telephones, timers, and other sound devices. Active buzzer 5V Rated power can be immediately connected to a continuous sound; this section's dedicated sensor expansion module and board can complete a simple "plug-and-play" circuit design. Mechanical, electromechanical, or piezoelectric buzzers are auditory signalling devices. Buzzers and beepers are used as alarms, timers, and user input confirmations (mouse click, keystroke). DC voltage produces single-tone sound. This type may produce huge sound volumes with a properly designed resonant system. Future Electronics has several common types by Type, Sound Level, Frequency, Rated Voltage, Dimension, and Packaging Type.

Result

All user data will be sent via cloud. Any suspicious activity will alert the user. Due of its compactness and usability, the Arduino Uno is the main processor. A user-configurable web page or android app can control and monitor load. Users can submit commands using the Wi-Fi module's IP. Wi-Fi module can connect to any nearby wireless modem. A Wi-Fi module's programme performs commands. The Wi-Fi module is controlled by loads. Web page and app indicate load status (ON or OFF). Fig.7 depicts the result.

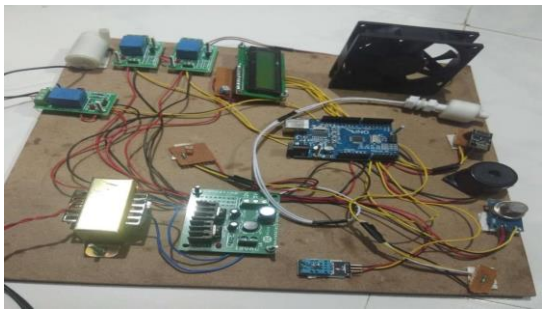

Fig. 7: Result

Conclusion

This project shows how to build a smart home automation controller. IOT can turn home appliances into smart devices with the design control unit. We modified their fan speed. Reduces fan remote use. In another module, we've replaced traditional bulbs with LEDs to offer automatic brightness adjustment. The LED bulb changes its brightness according to the outside brightness to eliminate unnecessary electricity usage due to manual switching. LDR gives clever automatic light control. Implementing both modules and data analytics on their outputs can minimise energy and maintenance expenses. Web applications can display module info. Home automation is wide-ranging. Future implementations will include hospitals, industry, and environmental monitoring to improve system performance.

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