INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 07 ISSUE: 05 | MAY - 2023 IMPACT FACTOR: 8.176 ISSN: 2582-3930

INDUSTRIAL ENERGY MANAGEMENT SYSTEM USING IOT

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Abstract— Monitoring and keeping track of your electricity consumption for verification is a tedious task today since you need to go to the meter reading room and take down readings. Well, it is important to know if you are charged accordingly so the need is quite certain. Well, we automate the system by allowing users to monitor energy meter reading Load scheduling, and overload load protection through the internet. The Cost of the consumed power is also displayed for a user. The proposed system measures the amount of power consumed and uploads it to the cloud, from which the concerned person can view the reading, amount of used power, and status of the load. The user can fix the real-time load scheduling with the help of RTC and the interface system. The proposed system neglects the regular digital meter reading system and allows remote access to the electronic meter. It is an IoT energy monitoring system and load protection that can be used in many applications, which include power billing devices, strength management in the smart grid, and home automation. The design is primarily based on a low-fee use of non-invasive CT sensors, SD3004 electric-powered electricity dimension chip, and ESP8266 and Atmega microcontroller for retrieving data from sensor nodes and sending information to server the internet.

Keywords— Automated Energy Management, Energy management system, Energy Monitoring, Internet of Things

I. INTRODUCTION

This information benefits the consumers with energy consumption awareness and the quality of power based on energy parameters. This will, directly and indirectly, pay back the economy, society, and environment. The Arduino-based controller is an efficient tiny device to sense and processes real-time data and also provides a better response with system integration.

The data obtained is then sent to the cloud through the internet. Data obtained can be easily sent wirelessly over long distances without any noise disturbance using the internet. As the data is directly sent to the cloud there is no occurrence of range and distance problems and is highly accurate and efficient because of no human interference. Other wireless technologies such as Zigbee, Bluetooth, etc. have limited range and thus cannot be used over very long distances effectively. This project envisages the use internet and the concept of

IOT by which the base station, as well as users, remain updated with the current consumed units, changing the present problems faced by the electricity board and the user. The increasing generation needs empowered gadgets with wireless technology which includes Bluetooth, Radio Frequency Identification, Embedded sensors, and many more. IOT technology has grown from its beginning and now presently widely using it. Electricity plays an important role in our life. Nowadays as the number of consumers is increasing rapidly it became very hard to handle the electricity requirements.

II. RELATED WORK

In the state of the art, different projects were found that address the management of loads at a domestic level from different approaches. For instance, Khan et al. in [12] conducted a systematic review of various home energy management schemes. Several topics were discussed, such as the advantages of HEMS, the coordination of Distributed Energy Resources (DER) (local generation) and/or appliances mixed with different tariff schemes that lead to efficient electrical energy usage, and also the challenges of hardware that each architecture faces.

In addition, Qureshi et al. investigated in [13] the existence of energy management systems for smart homes. According to the flaws that they found in the reviewed projects, they proposed an energy management scheme for smart homes based on the Internet of Things (IoT). Their design has a security mechanism to control end-to-end communication and the use of smart scheduling and time management for controllable and non-controllable household loads to monitor and reduce energy consumption. Additionally, some researchers have studied the effects resulting from demand control. For example, in [14], the National Renewable Energy Laboratory (NREL) of the United States conducted a study to identify the most effective way to reduce plug load energy use, using three different approaches One of them and the most effective method was an automated energy management system which turns off equipment when it is unused for a certain period. In addition, 126 persons were tested with this technique and obtained a 21% energy reduction from the baseline. Klein et al. in [15] simulated the operation of a multi-agent system. Their strategy is about taking real information from a building and combining and combining it with parameters given by the occupants in order to manage and coordinate the different devices inside the building. A 12% reduction in energy consumption and a 5% improvement in occupant comfort are the impacts they achieved. The proposal was never implemented in the real world. Similarly, a comprehensive automation system for buildings was discussed in [16], where they demonstrated, through a simulation, how the use of electrical energy is reduced by controlling objects

like heating ventilation, air-conditioning, lighting, and plugs. On the other hand, some other studies are focused on the development or implementation of algorithms in the demand-side energy management framework. That is the case of Ahmed et. al in [17]. For HEMS architecture, they created a new real-time load controller with a scheduling technique based on a Binary Tracking Search Algorithm (BBSA). The goal of this project is to achieve energy savings and limit household peak demand based on the scheduled operation of various appliances according to specific times, resident comfort restrictions, and priorities. Similarly, ref. [18] implemented a reinforcement learning algorithm to a home energy management system with the purpose of optimizing the household electric appliance's power demand. It is important to highlight that, in the presented work, a smart meter is the source of data for the applied algorithm. According to the simulations, the approach this research took can save between 6.23% and 11.54% of electricity costs.

III. WORKING

The proposed System is used to collect and analyze the data from energy meters and temperature sensors. In this work, a voltage regulator is chosen for the simulated voltage rating for the energy consumption data.

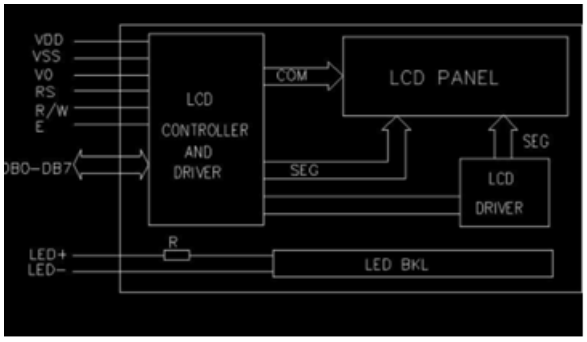

Figure 1. LCD Pin Description

This circuit consists of ATMEGA 328 p which is used to collect the data from the sensor and post it to the main unit through a wireless transceiver. It has 14 digital I/O pins, of which 6 can be used as PWM outputs and 6 analog input pins. The chip needs power so 2 of the pins, Vcc and GND, provide it power so that it can operate. The Atmega328 is a low-power chip, so it only needs between 1.8-5.5V of power to operate.

ATmega328 is an eight (8) bit microcontroller. It can handle data sizes of up to eight (8) bits. It is an AVR-based microcontroller. Its built-in internal memory is around 32KB. It operates ranging from 3.3V to 5V. It has the ability to store the data even when the electrical supply is removed from its biasing terminals. Its excellent features include cost efficiency, low power dissipation, a programming lock for security purposes, real timer counter with a separate oscillator. ATmega-328 is an AVR microcontroller having twenty-eight (28) pins in total.

The devices may be run mostly via their own embedded software or firmware, but they can also offload a lot of the processing to cloud-based software via the Internet, where they can crunch more data. Some use advanced algorithms that let them learn from and adjust to various stimuli and patterns (letting them program themselves, to an extent). This sending and processing of the sensor data are often nearly instantaneous (thanks to the usually lightning-fast speeds of Internet communication), allowing the devices to react in real-time. Internet, things, Internet of things, Internet of Everything! These are some of the buzzwords you may have been hearing, reading & very likely talking about endlessly. These are more than just keywords; IoT (Internet of Things) is a technology concept and/or an architecture that is an aggregation of already available technologies. Similar to the way in which Internet has changed the way we work & communicate by connecting us (humans) through World Wide Web, IoT aims to take this connectivity to the next level by connecting various devices to the Internet – facilitating human-machine, machine-machine interactions also. The analog sensor outputs raw data in analog format. There is a significant range of analog sensors such as temperature whose output is delivered in the analog domain. The application SoC needs to collect the output in raw format and convert it to digital for processing.

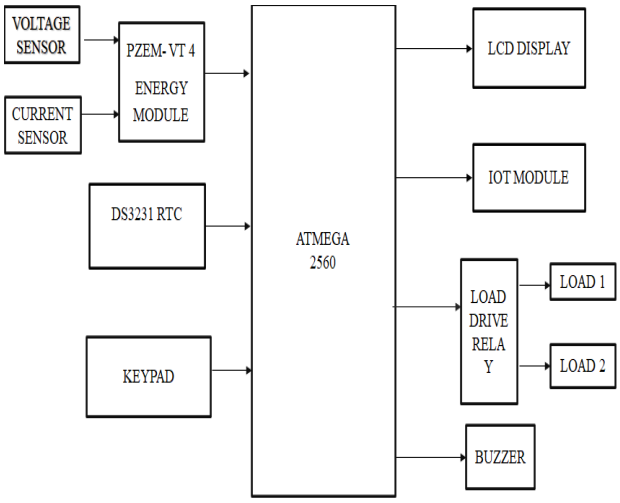

Figure 2: Block Diagram

IV. THE HARDWARE DESIGN

A. *Communicating using the ATEMGA 328P*

This circuit consists of ATMEGA 328 p which is used to collect the data from the sensor and post it to the main unit through a wireless transceiver. It has 14 digital I/O pins, of which 6 can be used as PWM outputs and 6 analog input pins.

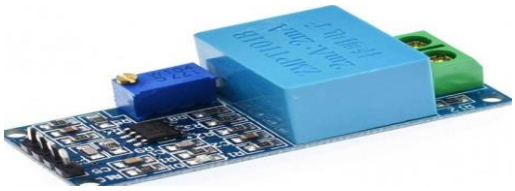

Figure 3:Voltage sensor

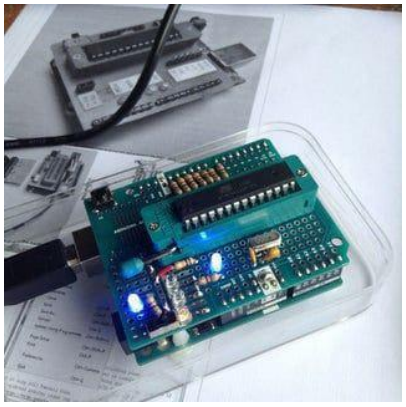

Figure 4: ATEMGA 328P

B.LCD DISPLAY:

The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or others which are compatible with HD44580. In this project document, we will discuss character-based LCDs, their interfacing with various microcontrollers, various interfaces (8-bit/4-bit), programming, special stuff, and tricks you can do with these simple-looking LCDs which can give a new look to your application. LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD is a very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi-segment LEDs. The reasons are: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations, and so on. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling the display, etc.

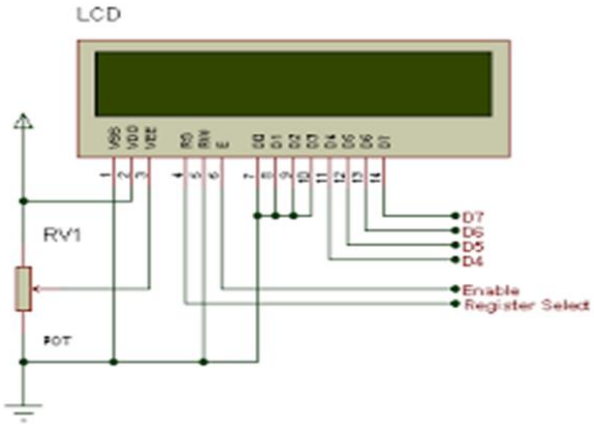

Figure 5. LCD Interface Circuit

Figure 6.LCD with microcontroller

The LCD standard requires 3 control lines and 8 I/O lines for the data bus. Liquid Crystal Display is a very important device in embedded systems. It offers higher flexibility as the user can display any data on it.

Figure 7. 16x2 LCD

The microcontroller ATmega328 is used because of its ease of use and programmability via IDE, available program memory, and inbuilt A/D converter.

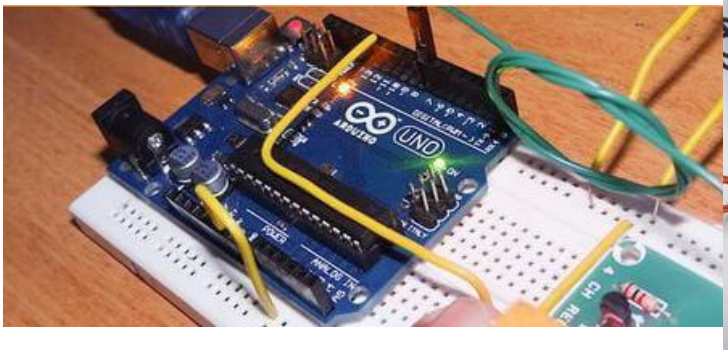

Figure 8. ARDUINO UNO ATEMGA 328P connected with the Microcontroller.

The microcontroller is the main processing of collecting, processing, and output of the data. Atmega 2560 is used because of Program and data memory are larger when compared to another microcontroller. The microcontroller is the main processing of collecting, processing, and output of the data. Atmega 2560 is used because of Program and data memory are larger when compared to another microcontroller.

B .DS3231 RTC

DS3231 RTC is a Precise Real-Time Clock Module with 32Kbit EEPROM and a built-in 10-bit temperature sensor having a resolution of 0.25C. The DS3231 RTC module Precise Real-Time Clock Module is a low-cost, extremely accurate I²C real-time clock (RTC) with an integrated temperature-compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input and maintains accurate timekeeping when the main power to the device is interrupted.

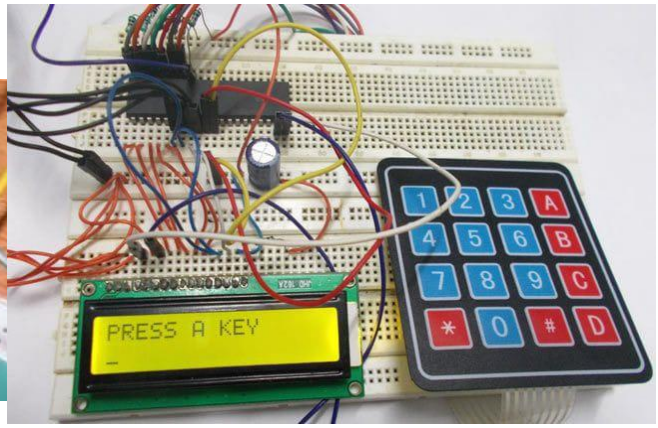

Figure 9. Key Pad 4x4

V. RESULTS

As the Uno board has a 16 MHz crystal we need to change the clock frequency from 8 MHz to 16 MHz.

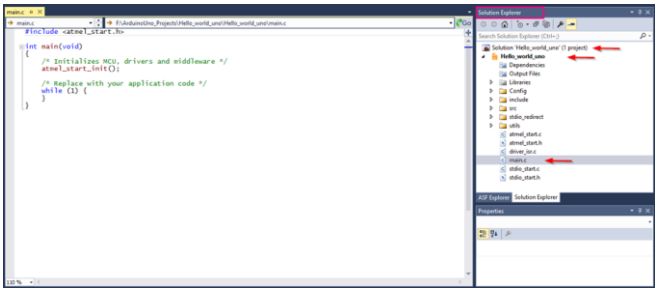

Figure 10. Data packets I/O via Atmel studio.

This number will be used to calculate the correct register values required to produce a given Serial port baud rate.

VI. CONCLUSION

The following conclusions were drawn:

1. The existing system has some the problems like manual work, Human errors, inaccurate meter readings, corruption, load tripping & load schedule.

2. The propagated model is used to calculate the energy consumption of the household, and even make the energy unit reading to be easy and accurate. Hence it reduces the wastage of energy and brings awareness to all. Even it will deduct the manual intervention.

3. An IoT Based Automatic Electrical Energy Meter Billing System was successfully achieved.

4. Embedded systems are emerging as a technology with high potential. In the past few decades, microprocessor-embedded systems have dominated the market

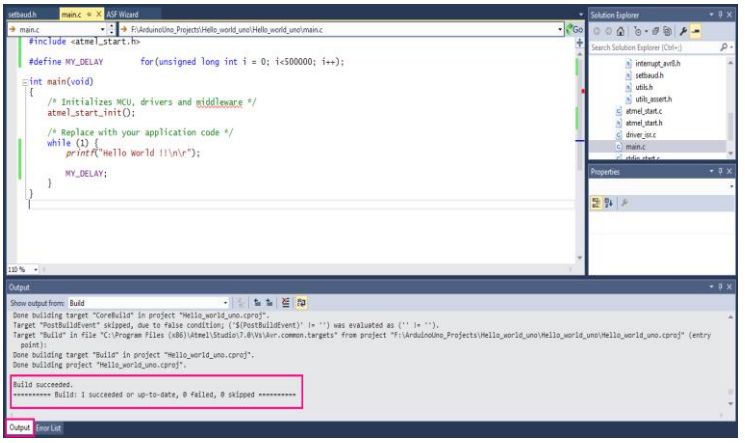

Figure 11.Compiling the program.

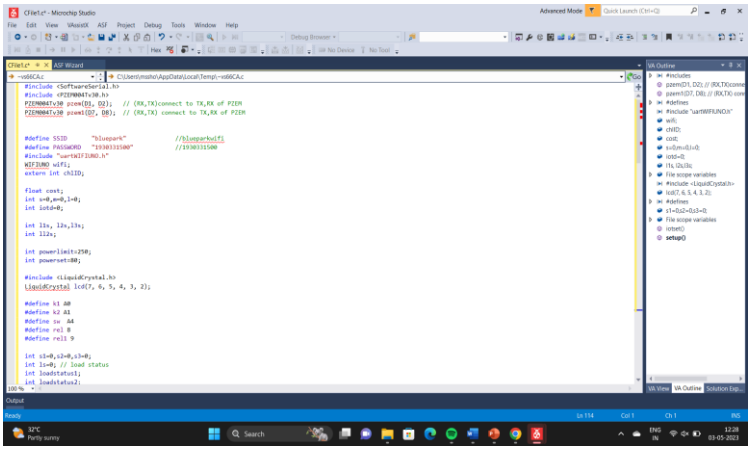

Figure 12.Sending SMS.

5. Regarding the collected requirements, the complexity of management and counting can be achieved with the help of electronic devices.

6. This system provides an effective watt-hour recording system in comparison with traditional methods in terms of productivity and efficiency

7. In the proposed system the electricity connection to each user will be given only to the registered user and the smart billing will be done via IoT (Internet of Things).

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