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Energy Efficiency for Secured Smart Village using IoT

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Abstract: ***This paper is all about research and implanting smart village based on IoT technology. IoT is a technique that is capable to transfer data in any networks without asking any response from human. It can connect any electrical and electronics device using any network topology – any time anywhere. The word Smart usages informational and communication technology with IoT technique to solve rural problems. This technique will eliminate the traditional way of agriculture. In smart village agriculture is cheap and efficient using renewable energy. Security is measure concern nowadays. Using IoT technique, we can make the villages more secure. These are all wonders usefulness we can get IoT (Internet of Things) technique.***

Keywords : Internet of things (IoT), Arduino, Solar panel, Servo motor, LDR, Register, GSM module, Wi-Fi module, P.I.R sensor, Ultrasonic sensor, Soil Moisture sensor, Temperature and Humidity sensor.

I. INTRODUCTION

Smart Village application uses advance technology like IoT, for providing renewable energy, smart security, and smart agriculture using any networks. It provides efficient and reliable data transmission under integrated system using wide area networks. It provides a new technology for generating more renewable energy and modern approaches for farming as well as smart security service using IoT application. This paper explains about generating more renewable energy and monitor agriculture as well as Security system with the help of IOT (Internet of Things). The complete application systems contain various subsystems like Wifi module, GSM module, Sensor units is shown in Fig.1.

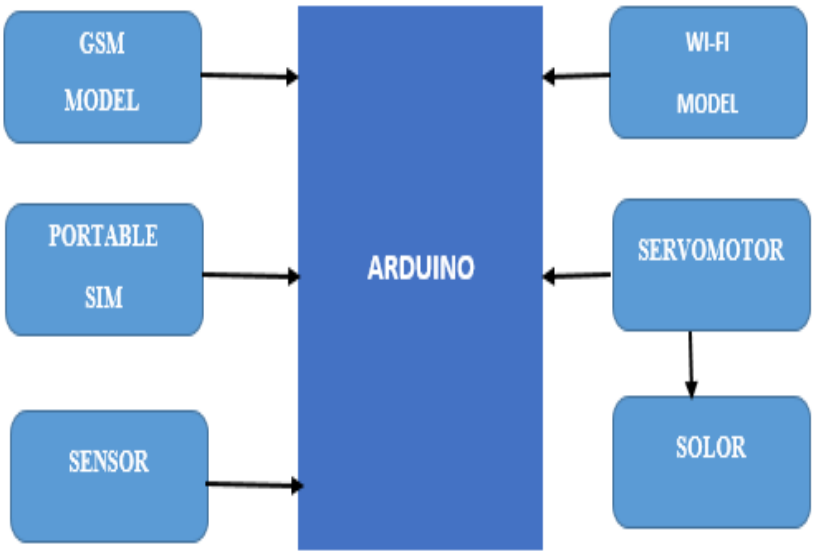

Fig. 1 Central Controller

A. *Methodologies Of Arduino*

1) *Arduino:* The Arduino is open source project. It creates microcontroller based kits to build electronic devices that can sense and control physical devices [1]. Arduino can read inputs, for example light, pressing a button and produce an output. Arduino language is a set of C/C++ function. Arduino microcontroller board based on the AT mega 2560 as shown in Fig.2. Sensors are attached to it and updating will be done on web server [2].

Fig. 2 Arduino micro-controller

B. Features Of Arduino

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

According to various parametric features, the values according to the usage are shown below:

1) Microcontroller: ATmega328
2) Operating Voltage: 5V
3) Input Voltage (recommended): 7-12V
4) Input Voltage (limits): 6-20V
5) Digital I/O Pins: 14 (of which 6 provide PWM output)
6) Analog Input Pins: 6
7) DC Current per I/O Pin: 40 mA
8) DC Current for 3.3V Pin: 50 mA
9) Flash Memory: 32 KB of which 0.5 KB used by bootloader
10) SRAM: 2 KB (ATmega328)
11) EEPROM: 1 KB (ATmega328)
12) Clock Speed: 16 MHz

C. Solar Panel

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. A photovoltaic (PV) module is a packaged, new types of solar panels have been occuring, some of the most efficient solar panels are connect assembly of typically 6×10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 watts. The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few commercially available solar modules that exceed 22% efficiency and reportedly also exceeding 24%. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes an array of photovoltaic modules, an inverter, a battery pack for storage, interconnection wiring, and optionally a solar tracking mechanism as shown in Fig.3.

Fig.3 Solar panel

D. Servomotor

A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft. The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops as shown in Fig.4.

Fig.4 Servo motor

E. Gprs/Gsm Module

GPRS (General Packet Radio Service) is a mobile data service which is packet oriented. GPRS module establishes connection between a computer and GPRS system. GSM/GPRS module can be integrated within an equipment as shown in Fig.5. SMS (Short Message Service) usage the GSM module. GPRS system provides data rates of 50 to 115 kbps. It is easy to transfer data and develop embedded system application using GSM module. The GPRS Class 12 is integrated with GSM(850-1900MHz).The modem can either be connected to PC serial port directly or to any microcontroller.The supporting features like Voice, SMS, Data/Fax, GPRS and integrated TCP/IP stack[1][2].

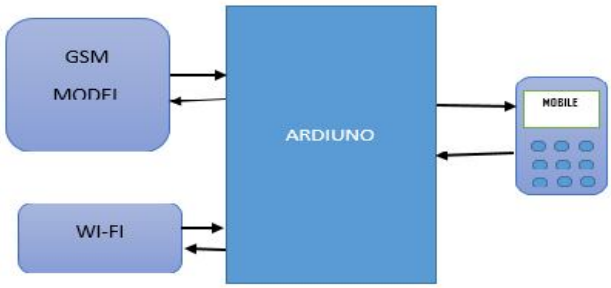

Fig.5 GSM Module and WIFI connected with Arduino

This GSM Module can accept any GSM network operator. There are Different kind of GSM module Available in Market but Most popular Module is SIM900 so used SIM900 in this Tutorial .GSM Modules Manufactured by different companies so most of the GSM modules Require 12v Dc input power Supply but some of them Require 15 v Dc so don't forget to check the input voltage for the GSM module in this project we using 12v input dc base GSM module. Insert Your SIM card to Module and Lock it carefully Connect Power adapter and Turn on the ModuleNow wait for some time because it will take some time to establish connection with BTS. When the Module Connection established successfully with the Mobile network so the present status led on GSM Module board will blink continuously every 3 seconds .you can check the GSMmodule that it is working fine or Not by making a call on that number which you insert on GSM module if you hear a ring back it means the GSM module is good and established a successful connection with Mobile network. The ESP8266 WiFi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that's just out of the box). The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

II. SENSORS USED IN IOT

A. Ultrasonic Sensor

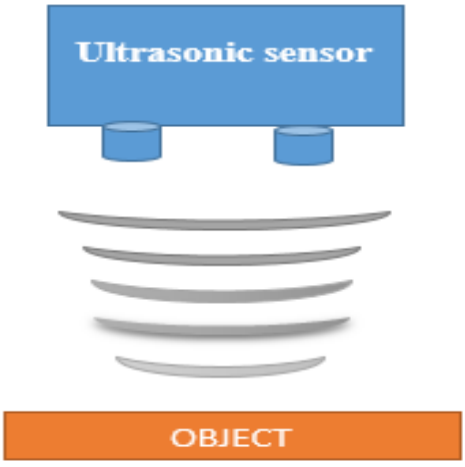

Fig. 6 Ultrasonic Sensor

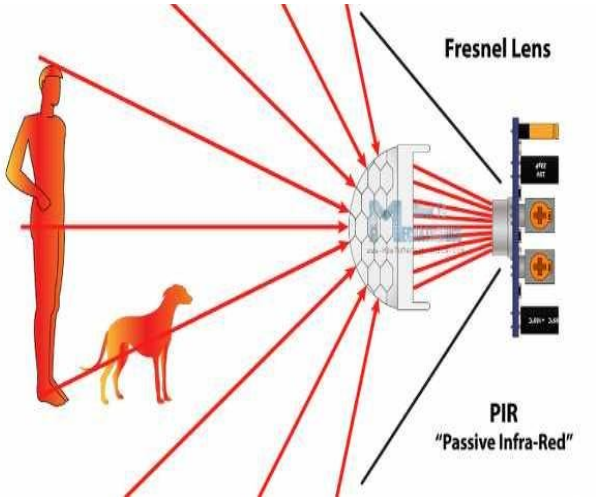

Fig.7 PIR Sensor

The Ultrasonic Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. The sensor has 2 openings on its front as shown in Fig.6. One opening transmits ultrasonic waves, (like a tiny speaker), the other receives them, (like a tiny microphone).

The speed of sound is approximately 341 meters (1100 feet) per second in air. The ultrasonic sensor uses this information along with the time difference between sending and receiving the sound pulse to determine the distance to an object. It uses the following mathematical equation

Distance = Time x Speed of Sound divided by 2

Time = the time between when an ultrasonic wave is transmitted and when it is received

You divide this number by 2 because the sound wave has to travel to the object and back.

B. Pir Sensor

Sensitivity of ultrasonic sensors leads to false trigger. For example, excessive air motion can cause the sensor to trigger. This is the disadvantage of ultrasonic sensor for its high sensitivity.Inorder to overcome this disadvantage, PIR sensors are used [10] as shown in Fig.7. A passive infrared (PIR) sensor is an electronic sensor that measures infrared (IR) light radiating from objects around its vicinity. PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range [11]. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors [3]. Due to its feasibility and flexibility, we can get proper range of the entity and hencePIR sensors can be implemented throughout the farming area and that too with a low power supply unit [9].

1) *Dual Technology Sensors :* Dual Technology Sensors is one of the most significant techniques of combining PIR sensor with ultrasonic sensor for precise
2) *Integration of Dual Technology Sensor*

Integrationof both Ultrasonic sensor and Passive Infrared sensor into a single application, it is necessary to ensure compatibility with each other. The components needed when integrating an ultrasonic sensor and a PIR sensor will vary from application to application. In order to interface the sensors together; Arduino provides a command to this integrated system [3]. Thus the Dual service integrated technology is implemented to provide low cost Monitoring system for Smart Village. N with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits as shown in Fig.8.

A photoresistor is made of a high resistance semiconductor. In the dark, a photo resistor can have a resistance as high as several megohms (MΩ), while in the light, a photo resistor can have a resistance as low as a few hundred ohms.

Fig. 8 LDR Sensor

C. Soil Moisture Sensor

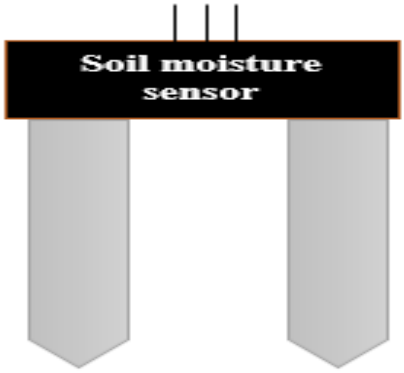

Fig. 9 Soil Moisture Sensor

Basically in Smart Farming, moisture content in the soil is a major factor for determining plant growth. Soil moisture sensor is a resistive sensor [5]. It determines the change in resistance of the soil between two probes which depends upon water content in it. Since water is a good conductor of electricity in the presence of ions [8]. So, greater the amount of electrolytes in the soil, greater will be the conductivity of the soil, means that the resistance of the soil decreases promptly[4]. It plays a vital role as a Decision Tool for farmers by providing
soil information and field variation.

D. Temperature and Humidity Sensor

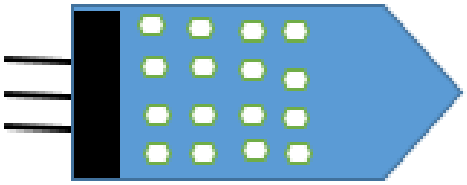

Fig.10 Temperature and Humidity Sensor

The Temperature and Humidity Sensor (or hygrometer) senses, measures and reports the relative humidity in the air. It therefore measures both moisture and air temperature. Relative humidity is the ratio of actual moisture in the air to the highest amount of moisture that can be held at that air temperature. The warmer the air temperature is, the more moisture it can hold. Humidity / dew sensors use capacitive measurement, which relies on electrical capacitance. Electrical capacity is the ability of two nearby electrical conductors to create an electrical field between them. The sensor is composed of two metal plates and contains a non-conductive polymer film between them. This film collects moisture from the air, which causes the voltage between the two plates to change [6]. These voltage changes are converted into digital readings showing the level of moisture in the air. The temperature is proportional with absolute humidity.

III. THE PRINCIPLES OF IoT

A. Information

The more number of information we have, the better decision we can make. By information of real time moister level can help us to provide better information of the natural ecosystem. It is obvious that having more information helps making better decisions.

B. Monitoring

The monitoring the data is another advantages of IoT. Using IoT monitoring System we can get accurate temperature, humidity and other components in the air of the farm. This data can be use farther to collect more information that was not easy to collect in the past [7]. Furthermore, monitoring the working of products can and will improve safety.

C. Time

IoT can save a large amount of time. And in today busy life saving time is more important

D. Cost

An IoT advantage is low cost technique. All the components and equipment's are cheaply available and large scale production of sensors is possible.

E. Integration with Dat

The data gathered by the sensor can become useful for an individual and society. The physical device uses the data collected by the sensor and produces output data used to make the current system more efficient.

IV. LIMITATIONS OF IoT

The limitations of IoT includes the following:

A. Compatibility
B. Complexity
C. Privacy/Security
D. Technology takes control of life.
E. Less employment

V. CONCLUSION

Internet of Things service is very powerful, reliable and cost effective technology to implement the idea of "Smart Village" that aims to authorize villages with advance rural connectivity through web service, solar tracking system, and measurement of environment factors like Soil moisture, temperature, humidity and implementation of real time monitoring using GSM system. The future scope of this work includes Livestock monitoring –It provides active view of stock to determine location as well as the detection of animal and thieves. It have ability to monitor factors such as temperature, humidity and soil moisture helps to ensure quality output, potentially leading to greater farmer satisfaction and profitable farming. IoT is provided quality of service for client or farmer. Renewable energy– Using solar tracking system we can generate large amount of energy. LDR is use for tracking the sun motion.

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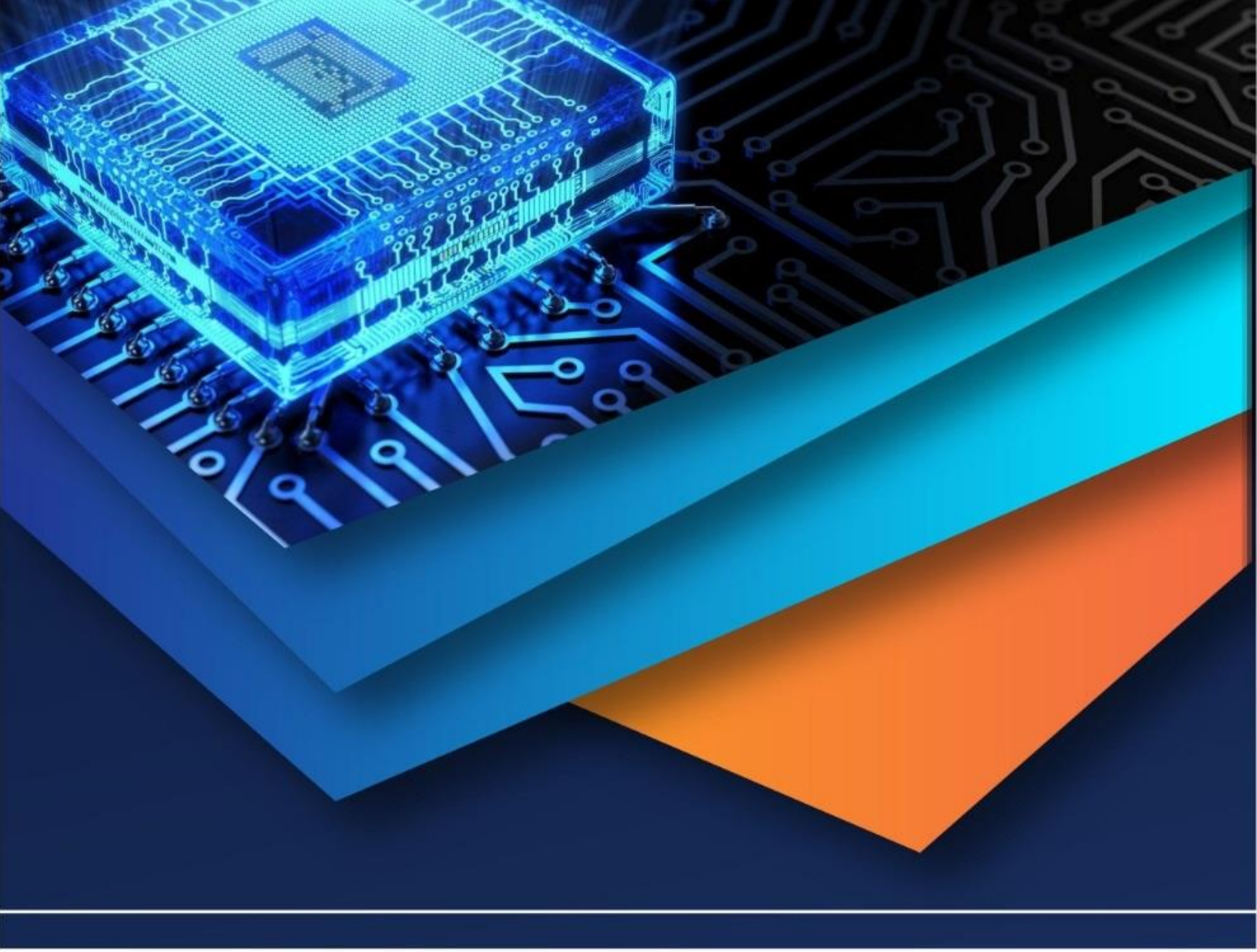

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