Control of Brushless DC motor using Internet of Things

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***Abstract*— DC drive systems are often used in many industrial applications such as robotics, actuation and manipulators. The purpose of this project is to control the ON/OFF of Brushless DC (BLDC) motor by using IOT. The Internet of Things(IOT) refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other internet-enabled devices and systems. Brushless DC Motor (BLDCM) has been widely used in industries because of its properties such as high efficiency, reliability, high weight to torque ratio. By utilizing this IOT control, the rate can be tuned until it gets like the desired output that a user wants**.

I. INTRODUCTION

The Brushless DC motor is ON/OFF by using IOT to control at anyplace. By using the android to connecting the both IP address at one certain web domain to ON/OFF the BLDC motor. Where ever the user goes the user ON/OFF the BLDC motor by using the web domain. Arduino controller is used to receive and transfer the signals from the internet by using the Ethernet shield. In arduino controller, programmed the function with the certain web domain IP address. The Ethernet shield is used to receive signals from the web domain. So, that web domain to ON/OFF the Brushless DC motor. The Internet of things is the internetworking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items— embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IOT-GSI) defined the IOT as "the infrastructure of the information society." The IOT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. When IOT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IOT will consist of almost 50 billion objects by 2020. Typically, IOT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to user in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to areas such as smart cities. "Things," in the IOT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring or field operation devices that assist firefighters in search and rescue operations. Legal scholars suggest looking at "Things" as an "inextricable mixture of hardware, software, data and service". These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. Current market examples include home automation (also known as smart home devices) such as the control and automation of lighting, heating (like smart thermostat), ventilation, air conditioning (HVAC) systems, and appliances such as washer/dryers, robotic vacuums, air purifiers, ovens or refrigerators/freezers that use Wi-Fi for remote monitoring. As well as the expansion of Internet-connected automation into a plethora of new application areas, IOT is also expected to generate large amounts of data from

diverse locations, with the consequent necessity for quick aggregation of the data, and an increase in the need to index, store, and process such data more effectively.

II. EASE OF USE

BLOCK DIAGRAM

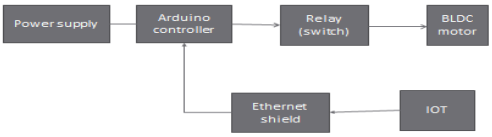

Fig 1:Industrial automation

WORKING

In arduino controller, programmed the function with the certain web domain IP address. The Ethernet shield used to receive signals from the web domain. The Arduino Ethernet Shield connects the Arduino to the internet in mere minutes. A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The TIP120 is an NPN Power Darlington Transistor. It can be used with an Arduino to drive motors, turn lights on, and drive other high power gadgets. The TIP120 acts as a power broker or gatekeeper between the Arduino realm and the high power realm composed of the PC fan and its battery pack. The Arduino can tell the TIP120 how much power to pass from the external battery pack to the PC fan but the Arduino does not share any of its power or share pins with the PC fan or its batteries. The TIP120 has three pins. One is called Base, which we will connect to any of the Arduino PWM pins. Through the Base pin, the Arduino can tell the TIP120 how much power to supply to the motor from the external battery pack. The TIP120 does the heavy lifting while Arduino sits back and gives orders through one of its PWM pins to the TIP120 Base pin telling it how much power to pass to the motor. The poor TIP120 has to then pass the requested power from the external power to the motor based on Arduino's request. An automotive battery is a rechargeable battery that supplies electric energy to an automobile. Traditionally, this is called an SLI, for starting, lighting, ignition, and its main purpose is to start the engine. Once the engine is running, power for the car is supplied by the alternator. Typically, starting discharges less than three per cent of the battery capacity. SLI batteries are designed to release a high burst of current, measured in amperes, and then be quickly recharged. They are not designed for deep discharge, and a full discharge can reduce the battery's lifespan. As well as starting the engine an SLI battery supplies the extra power necessary when the vehicle's electrical requirements exceed the supply from the charging system. It is also a stabilizer, evening out potentially-damaging voltage spikes. While the engine is running, most of the power is provided by the alternator, which includes a voltage regulator to keep the output between 13.5 and 14.5 V. Modern SLI batteries are lead-acid type and provide 12.6 volts of direct current, nominally 12 V. The battery is actually six cells connected serially. Battery electric vehicles are powered by a high-voltage electric vehicle battery, but they usually have an automotive battery as well, so that it can be equipped with standard automotive accessories which are designed to run on 12 V.so, the Brushless DC motor is ON/OFF by using IOT to control at anyplace. By using the android to connecting the both IP address at one certain web domain to ON/OFF the BLDC motor. Direct drive, brushless DC linear motors consist of a slotted stator with magnetic teeth and a moving actuator, which has permanent magnets and coil windings.

Existing system

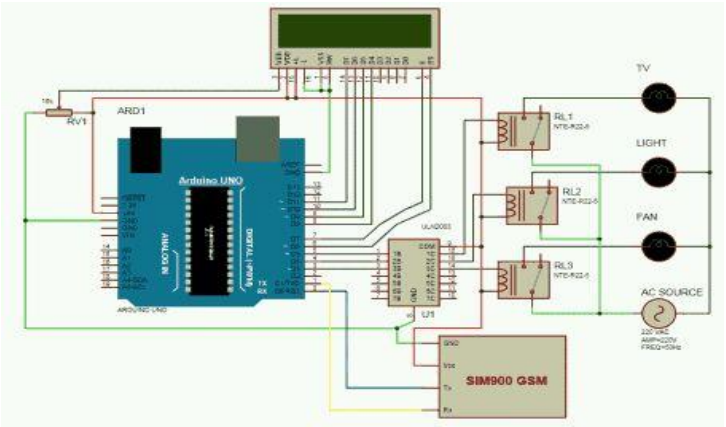

Fig 2: Existing system of home automation system

An isolated WSN with one coordinator, which is integrated into the PLC transceiver, is established in each room. The coordinator is responsible for transferring environmental parameters obtained by WSNs to the management station via PLCs. The control messages for home appliances are directly transferred using PLCs rather than WSNs.

Proposal system

Fig 3: Proposed system of industrial automation system

The Arduino Uno and Wi-Fi shield were used to implement the micro Web-server for the Home gateway in figure 4. Home gateway connects to the Internet a. The Arduino Uno is an open-source microcontroller that uses ATMEGA 328, an Atmel AVR processor which can be programmed by the computer in C language via USB port. Arduino Uno also has on-board 5 analog pins and 13 digital pins for input and output operations, supporting SPI and I2C which can be used to interface with other devices.

Power supply

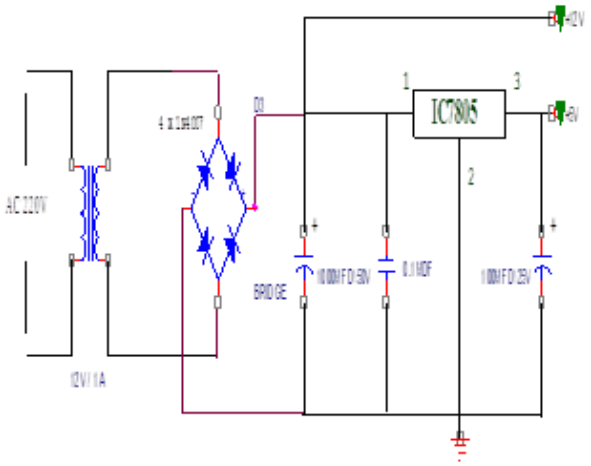

Fig 4:Power circuit

Arduino

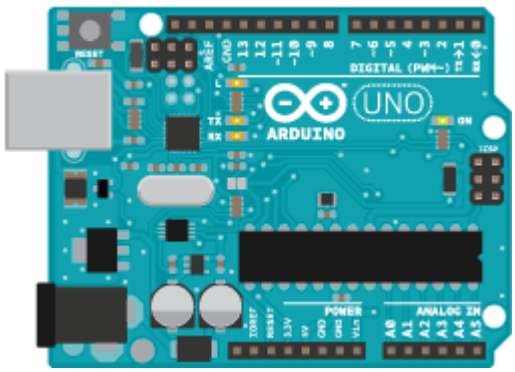

Fig 5:Arduino UNO board

Arduino is a computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

Arduino Ethernet Shield

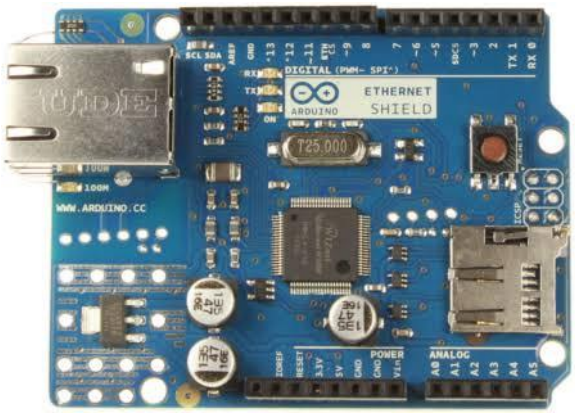

Fig 6:Arduino Ethernet Shield

The Arduino Ethernet Shield connects your Arduino to the internet in mere minutes. Just plug this module onto your Arduino Board, connect it to your network with an RJ45 cable (not included) and follow a few simple steps to start controlling your world through the internet. As always with Arduino, every element of the platform – hardware, software and documentation – is freely available and open-source. This means you can learn exactly how it's made and use its design as the starting point for your own circuits. Hundreds of thousands of Arduino Boards are already fueling people's creativity all over the world, every day. Join us now, Arduino is you! *Requires an Arduino Board (not included) Operating voltage 5V (supplied from the Arduino Board) Ethernet Controller: W5500 with internal 32K buffer

- Connection speed: 10/100Mb
- Connection with Arduino on SPI port

Technical Specs

The Arduino Ethernet Shield allows an Arduino Board to connect to the internet. It is based on the (Wiznet W5500 Ethernet chip (http://wizwiki.net/wiki/lib /exe/fetch.php?media=products:w5500:w5500_ds_v106e_141

230.pdf)). The Wiznet W5500 provides a network (IP) stack capable of both TCP and UDP. It supports up to eight simultaneous socket connections. Use the Ethernet library to write sketches that connect to the Internet using the Shield. The Ethernet Shield connects to an Arduino Board using long wire-wrap headers extending through the Shield. This keeps the pin layout intact and allows another Shield to be stacked on top of it. The most recent revision of the board exposes the 1.0 pin out on rev 3 of the Arduino UNO Board. The Ethernet Shield has a standard RJ-45 connection, with an integrated line transformer and Power over Ethernet enabled. There is an onboard micro-SD card slot, which can be used to store files for serving over the network. It is compatible with the Arduino Uno and Mega (using the Ethernet library). The onboard micro-SD card reader is accessible through the SD Library. When working with this library, SS is on Pin 4. The original revision of the Shield contained a full-size SD card slot; this is not supported. The Shield also includes a reset controller, to ensure that the W5500 Ethernet module is properly reset on power-up. Previous revisions of the Shield were not compatible with the Mega and needed to be manually reset after power-up. The current Shield has a Power over Ethernet (PoE) module designed to extract power from a conventional twisted pair Category 5 Ethernet cable. PoE module features as follows:

- IEEE802.3af compliant
- Input voltage range 36V to 57V
- Overload and short-circuit protection
- 12V Output
- High efficiency DC/DC converter: type 85% @ 80% load.
- 1500V isolation (input to output

Brushless motors are commonly used as pump, fan and spindle drives in adjustable or variable speed applications. They can develop high torque with good speed response. In addition, they can be easily automated for remote control Brushless DC motors are widely used as servomotors for machine tool servo drives. Servomotors are used for mechanical displacement, positioning or precision motion control.

Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays". Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts. Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition.

TIP120

The TIP120 is an NPN Power Darlington Transistor. It can be used with an Arduino to drive motors, turn lights on, and drive other high power gadgets. The TIP120 acts as a power broker or gatekeeper between the Arduino realm and the high power realm composed of the PC fan and its battery pack. The Arduino can tell the TIP120 how much power to pass from the external battery pack to the PC fan but the Arduino does not share any of its power or share pins with the PC fan or its batteries. The TIP120 has three pins. One is called Base, which we will connect to any of the Arduino PWM pins. Through the Base pin, the Arduino can tell the TIP120 how much power to supply to the motor from the external battery pack. That's it. The TIP120 does the heavy lifting while Arduino sits back and gives orders through one of its PWM pins to the TIP120 Base pin telling it how much power to pass to the motor. The poor TIP120 has to then pass the requested power from the external power to the motor based on Arduino's request.

Brushless DC electric motor

Fig 9. Brushless DC motor

Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutated motors (ECMs, EC motors) are synchronous motors that are powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor. In this context, AC, alternating current, does not imply a sinusoidal waveform, but rather a bi-directional current with no restriction on waveform. Additional sensors and electronics control the inverter output amplitude and waveform (and therefore percent of DC bus usage/efficiency) and frequency (i.e. rotor speed). The motor element of a brushless motor system is often a permanent magnet synchronous motor, but can also be a switched reluctance motor, or induction motor. Brushless motors may be described as stepper motors; however, the term "stepper motor" tends to be used for motors that are designed specifically to be operated in a mode where they are frequently stopped with the rotor in a defined angular position. This page describes more general brushless motor principles, though there is overlap.

Applications-Brushless DC electric motor

Brushless motors fulfill many functions originally performed by brushed DC motors, but cost and control complexity prevents brushless motors from replacing brushed motors completely in the lowest-cost areas. Direct drive, brushless DC linear motors consist of a slotted stator with magnetic teeth and a moving actuator, which has permanent magnets and coil windings. Produce linear motion are called linear motors. The advantage of linear motors is that they can produce linear motion without the need of a transmission system.

CONCLUSION

In this paper we propose a new architecture for the control system that uses a flexible industrial-based Android smartphone at a reasonable price and implemented by Ethernet shield and IBOARD Arduino as well as using web domain for system control configuration. The proposed architecture is used in a web services for communication between the remote user and the industrial device. All Android-based smartphone, the Ethernet shield connection is the support built, the industry access device to control can use the phone, 3G or 4G to access the Web page on hosting server using Android App or web domain.

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