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Brushless DC Motor Controlled by usingInternet of Things

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Abstract
This paper presents the study and control of the Brushless DC (BLDC) motor by using IoT. The BLDC drive systems are often used in many industrial applications such as robotics, actuation and manipulators. The Internet of Things (IoT) refers to the ever growing network of physical objects that feature an Internet protocol (IP) address for internet connectivity and the communication that occurs between these objects and other internet enabled devices and systems. The BLDC Motor 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.

Keywords: IoT, IP, BLDC Motor

I. INTRODUCTION

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. [1] In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IOT as "the infrastructure of the information society." [2]. 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 [3], [4] 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 [5]. 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 usher in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to areas such as smart cities [6]. The 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 [7].

II. HOME AUTOMATION SYSTEM

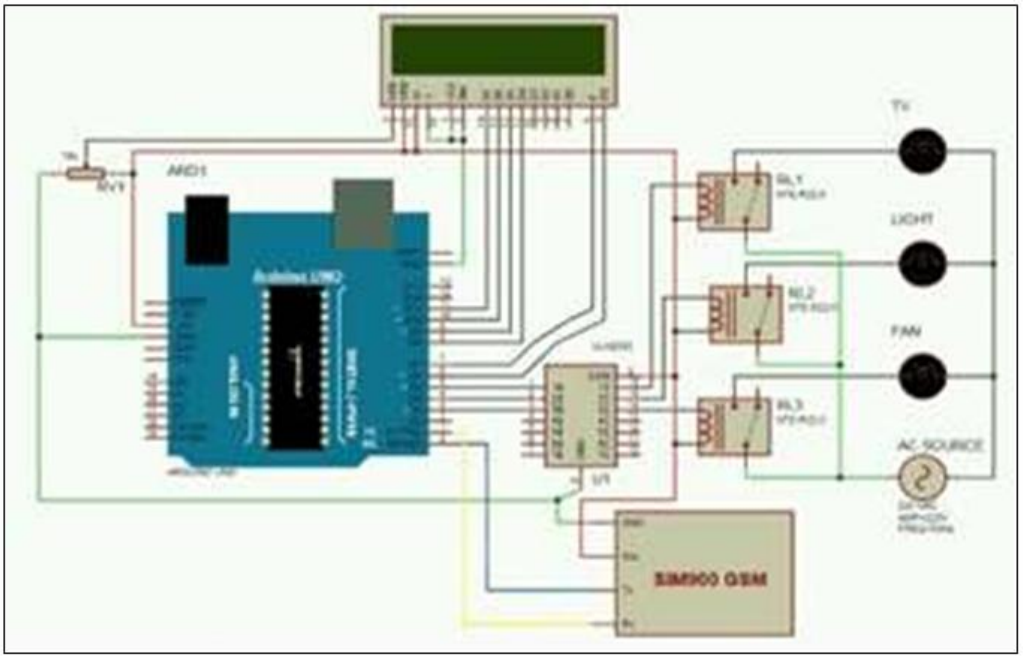

Fig. 1: Existing system of home automation

An isolated WSN with one coordinator, which is integrated into the PLC transceiver, is established in each room. The coordinatoris 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. The existing system of home automation is shown in Fig.1.

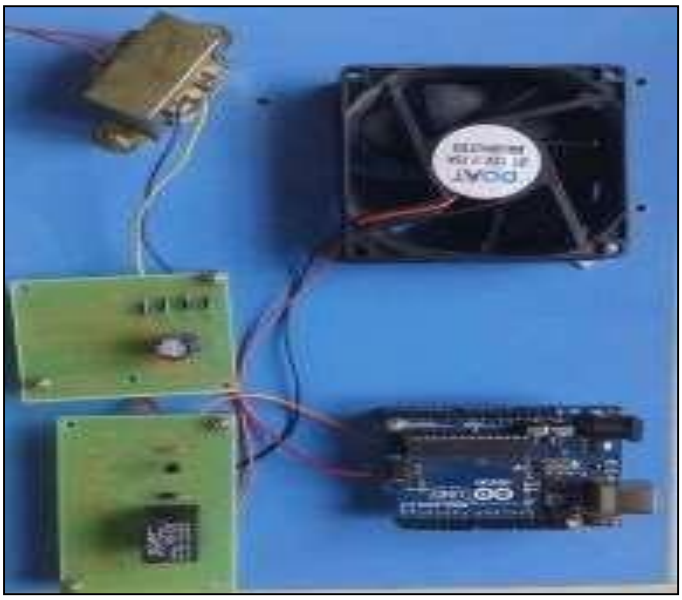

Fig. 2: Proposal prototype model

The Arduino Uno and Wi-Fi shield were used to implement the micro Web-server for the gateway in Fig.2. 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 [8].

III. IOT BASED BLDC MOTOR CONTROL

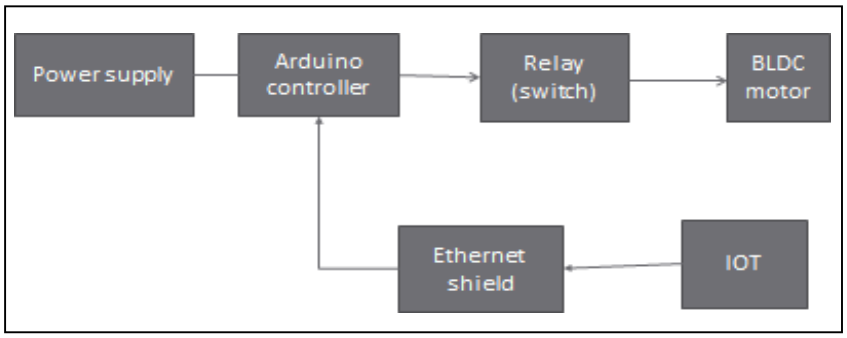

Fig. 3: Block diagram of IoT based BLDC Motor control

In arduino controller, programmed the function with the certain web domain IP address [9], [10]. 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. Relay is used where it is necessary to control a circuit by a separate low-power signal, or whereseveral 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 [11]-[14]. 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 [15]. In Fig. 3 shows the block diagram of IoT based BLDC Motor control. A typical 12 V, 40 Ah lead-acid car battery is used here. It provides 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 internet to control at distant places. By using the androidto connecting the both IP address at one certain web domain to ON/OFF the BLDC motor. In Fig. 4 shows the power supply circuitdiagram.

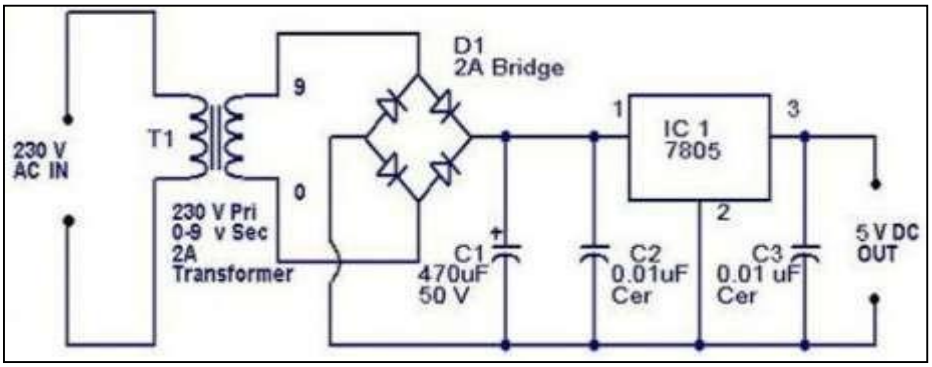

Fig. 4: Power supply

IV. ARDUINO UNO AND ETHERNET SHIELD

The Arduino UNO board is shown in Fig.5. 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 [16]. 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.

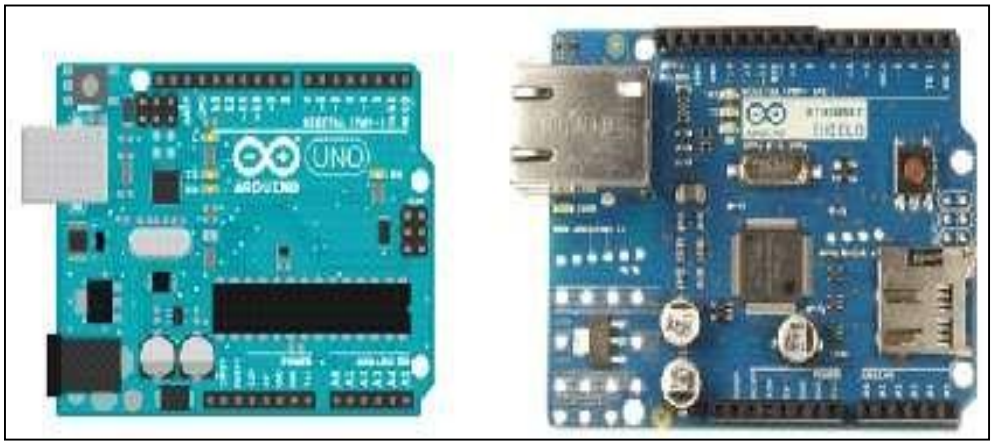

Fig. 5: Arduino UNO board Fig. 6: Arduino Ethernet Shield

The Arduino Ethernet Shield connects your Arduino to the internet in mere minutes as shown in Fig. 6. 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 [17]. Hundreds of thousands of Arduino Boards are already fueling people's creativity all overthe 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. The Fig. 6 shows the Arduino Ethernet Shield.

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. A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contractor. Solid-state relayscontrol 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. TheTIP120 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. InFig. 7 shows the brushless DC motor. The Brushless DC electric motor also known as electronically commutated 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 rathera 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) [18]. 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 generalbrushless motor principles, though there is overlap.

Fig. 7: Brushless DC Motor

V. CONCLUSION

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

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