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# IOT based control of DC traction motor

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Abstract
In this paper, the IOT based control of DC traction motor has been reported. Internet is the most widely used, high speed and easily accessible communication medium in the modern day world. The proposed system allows any person from any corner of the world to control heavy industrial machines. The proposed system is simple and highly effective in terms of cost and efficiency. In this system, the switching and the speed of the DC motor can be controlled by using a self-developed android application. The PROTEUS simulation confirmed the theoretical estimates of the performance of the proposed system.

Index Terms— IOT, android application, Internet, Traction motors.

## I. Introduction

Internet was used in the earlier times only for basic communication and information sharing. However, the evolution of internet has brought about a boom in the world by the concept of Internet of Things [1]. Today the power of internet is applied for doing many tasks like controlling a remotely placed server machine from anywhere in the globe. Supported by the internet, came the concept of smartphones which have aided the same by a great extent. Application specific android applications have been developed which perform tasks and minimize the human effort by a great extent. Many low cost and flexible monitoring systems have been developed using the concept of IOT collaborated with wireless modes of communication. IOT is defined as an environment in which objects (devices) are given unique identifiers and the ability to transfer data over a network without having human-to-human or human-to-computer interaction [2]. Many more ideas have been researched and developed. The Internet of Things is expected to play a key role in a range of domains, from factory automation to health-care [3]. However, a major limitation of these ideas is the fact that their reach is limited. The applications can only be controlled within a given environment and hence, the physical presence of the person concerned is required to some extent [4]. Android smartphones however have overcome this limitation because of its handy nature and excellent connectivity. Android is an open source framework and hence is widely popular amongst the users and smartphone manufacturers [5]. The proposed system allows the control person to control the system just by a click on his smart-phone. Alternatively, personal computers can also be used for the same. The system consists of very simple and easy to use equipments which can handle tasks as big as controlling the traction of any machinery using the concept of Internet of Things (IOT). The system will improve the efficiency of industries to a great extent. Also it will reduce the man power used substantially resulting in a great save in the company's revenue as human resource is very precious. By using this technology, ease of doing business can be achieved. For example, in nuclear reactors, after the chain reaction starts, one cannot go inside system. Continuous checking of the system is very necessary since even a small fault or some kind of leakage can affect people and can cover large area. So to keep an eye on everything happening inside a nuclear reactor, required electronic devices can be installed initially and later they can be monitored using IOT. These devices can be linked to many computers making a whole control room and even to smart phones so that emergency cases can also be handled. For traffic management system, a small electronic device is installed in the vehicles including speed sensors. When a vehicle crosses the speed limit, the vehicle data is automatically sent to the police control room and a challan is generated automatically which they have to pay or their license will be cancelled. In order to protect any vehicle, small electronic lock is fixed inside the engine. If a person finds that his/her vehicle has been stolen, they themselves can lock the engine with the help of their smart phones and the thief is no longer able to control the vehicle since the lock is inserted inside the engine and is very difficult to open it in such situations.

## II. Proposed Technique

The aim is to control heavy industrial machines using an android smartphone from anywhere in the world. An android application can be developed using softwares like Android studio. The developed android application can control and monitor the load with its user configurable front end. It will contain a list of all the places wherein the machines are located. The respective selection will link to the page where a widget will contain different values for speed control. Once the value for the speed is fixed, the data is sent from the application to an online web server. This operation can be carried out by the professional in- charge. The android application and the Wi-Fi-module are linked to an online cloud server which will store the required speed preset by the operator. The corresponding control data from the online web server will be received by the Wi-Fi module. The Wi-Fi module provides internet to the ARDUINO UNO microcontroller or a programmable logic controller (PLC) in cases of industrial drive control. The Wi-Fi module transmits the control data to the ARDUINO microcontroller. The microcontroller then receives the data from the module. Corresponding pulse width modulated pulses are generated from the microcontroller PWM pins. These pulses are fed to the motor driver. The motor driver IC can be easily powered from the microcontroller as it operates in the order of 5V to 36V. The motor driver hence drives the motor according to the pulses fed to it. The android application will also help in monitoring the running status of the machine. The system allows the operator to check the control and speed parameters of the machines. The Fig.1, 2 represents the basic block diagram of the proposed system wherein a man can operate various factory machineries just by a click of his smartphone application.

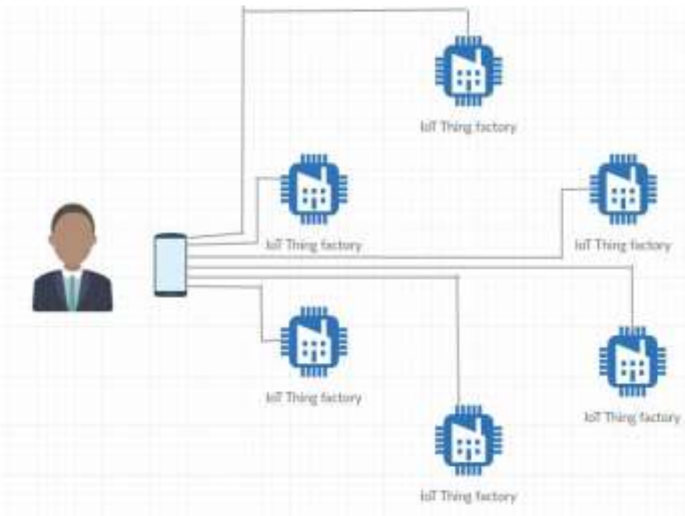


Fig.1. Block diagram representation

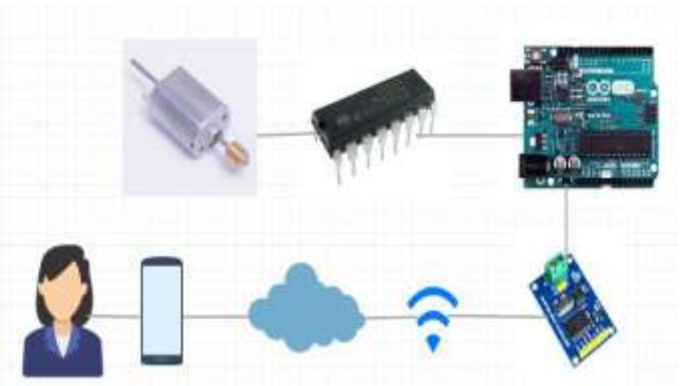

Fig.2. Diagrammatic representation

## III. Android Application

The android application is developed using an open source platform like android studio. The application thus developed will have options for both the operator and the control person. The application would provide a two-way control. The first mode of control can be a control where the controller can select the machine whose parameter is to be controlled. Once this is done, the current activity will be linked to the next activity which will contain different values for the speed control. Once the selection is made, authorization token will authorize the user using a predefined password in the application. Once the password matches with the predefined password, the internet on the phone sends the control data to the cloud web server. However, in contrast to the conventional cloud-centric architecture, virtual resources for the Internet of Things, a software architecture to resolve the tension between effective development and efficient operation of IoT applications has also emerged [6]. Now in the first mode of control, an operator can be physically present at the machine location and can download the required machine running parameters from the web server from time to time and thereby, he can operate the machine accordingly. In the second proposed method, the running parameters of the machine will be obtained by the microcontroller and through the code uploaded in the microcontroller, it will send required instructions to the motor driver through switching array and the machine will run at the given parameters.

## IV. Smartphone

There are nearly 3 billion smartphone users of which nearly 82 % use android. Out of the total available devices, 2.4 billion are IoT compatible [7]. The developed android application will be installed on the smartphone. The smartphone will use its internet connectivity to send over the control data to the web cloud servers such as firebase or one out of the many database platforms that are available. The android application will be user-friendly and easily accessible by all android smartphone users.

## V. Microcontroller

The arduino UNO microcontroller comes with the ATmega328P microcontroller embedded. ARDUINO UNO is designed to provide many facilities for communicating with the computers, an another ARDUINO and other on-board controllers [8]. The standard operating voltage for the board is 5V. However, the recommended input voltage ranges from 7V to 12V. It contains 14 digital input/output pins, out of which 6 are pulse width modulation enabled pins. There are 6 analog input pins present on the board. It supports a flash memory of 32 KB of which 0.5 KB is used by the boot loader. The clock speed is 16MHz. The SRAM and EEPROM are 2 KB and 1 KB respectively. Also the microcontroller has incredibly convenient sizing wherein its length and width are 68.6 mm and 53.4 mm respectively [9]. The arduino microcontroller will be loaded with a program written on arduino C. The program will be guiding the microcontroller to download the control data from the online cloud web server. The data will be fetched using the Wi-Fi module at regular intervals. This data will be in form of analog values 0-255. Accordingly the microcontroller can be used to modulate the pins of the motor driver IC to make the motor operate in different modes like forward motoring, forward braking, reverse motoring, reverse braking. Also the respective analog values received represent speeds where 0 represents 0 speed and 255 represents full speed. Fig.3 shows the arduino UNO microcontroller.


Fig.3. Diagrammatic representation

### VI. WI-FI Module

There are a number of ways in which the Arduino microcontroller can be connected with the internet. One way is using the Arduino UNO Wi-Fi board [10]. It has been represented in Fig 5. It is a microcontroller board with Wi-Fi module embedded in it. Another way is to use a separate ESP8266 Wi-Fi module. It has integrated TCP/IP protocol stack. It comes pre-programmed with AT command set firmware. It has 1MB Flash memory. It is IEEE 802.11 b/g/n Wi-Fi. It has 16 GPOI pins. It supports SPI as well as I2C communication protocols [11]. Predefined library is also available for coding. The fig.4 shows a ESP8266 Wi-Fi module.

Fig.4. ESP8266 Wi-Fi module

Fig.5. Arduino UNO Wi-Fi board

### VII. **Motor Driver**

In the simulations for the prototype, the motor driver integrated circuit L293D has been used. The L293D is a dual H-bridge motor driver IC. The Fig. 6 represents the IC. This IC is controlled using the arduino microcontroller and it serves as the final step for the proposed system. Using the motor driver IC, the motor can be made to operate in all the four quadrants. It has an output current of 600 mA and a peak output current of 1.2 A per channel. Output diodes are also included in the IC for protection against any back EMF produced by the motor. The output supply has a wide range from 4.5 V to 36 V [12].

Fig.6. L293D motor driver

### VIII. Simulation Results

The simulation of the system is very simple. First of all, the libraries of Bluetooth and Arduino need to be downloaded because these libraries are not predefined in proteus. These libraries are easily available online. The next step involves extraction of files from the zip folder that has been downloaded and including them in the library section present in the proteus folder (present in the installed drive). Rest everything is available in the software. On typing the keyword or the codes, the list appears in the part list.

To send the signal from Bluetooth, virtual terminal from the instruments section present in extreme left corner of the screen in the shape of waveforms right below the probes should be selected. On running the simulation, a virtual terminal appears. On entering the required codes in the terminal, the motor moves accordingly. Performance of the circuit is thus tested and corresponding boosted PWM signal is seen in the virtual oscilloscope. The waveform shown below in the virtual oscilloscope is the output PWM pulse from the driver circuit. The Fig.7 represents the simulation circuit diagram as drawn in proteus. Fig. 8 represents the waveforms obtained during the forward motoring mode of operation. Fig. 9 shows the virtual terminal overview of the same. Fig. 10 shows the simulation results when a slower speed is applied commanded.

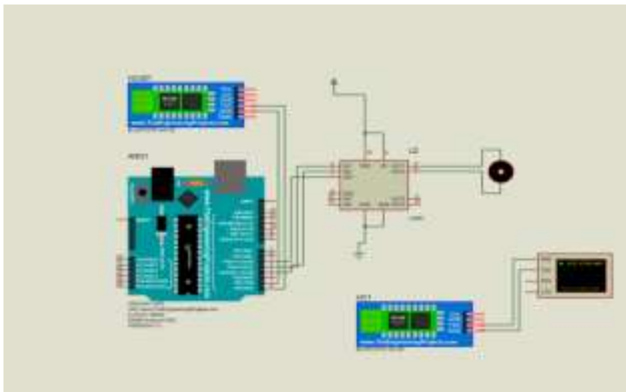

Fig.7. Proteus schematic of the circuit diagram

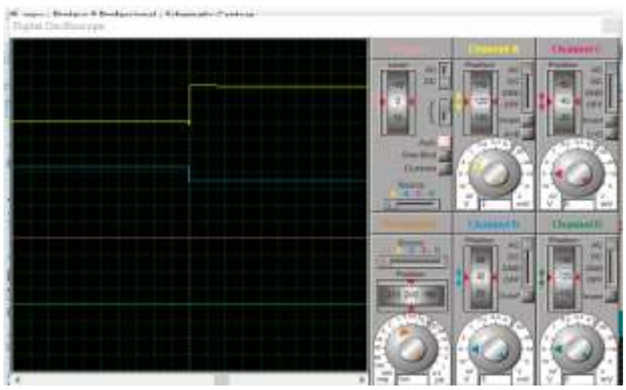

Fig.8. Forward motoring

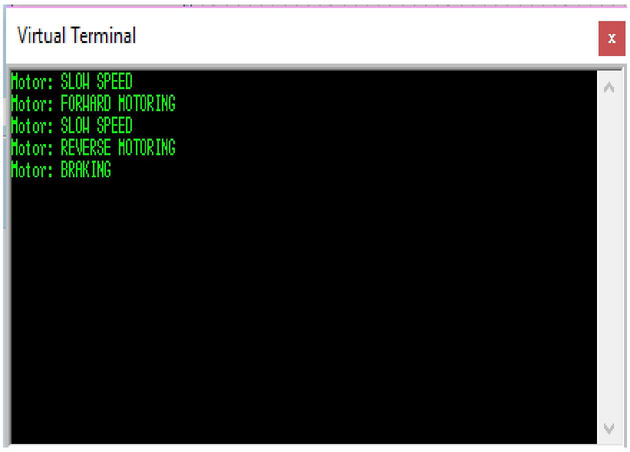


Fig.9. Virtual terminal at different modes of operation

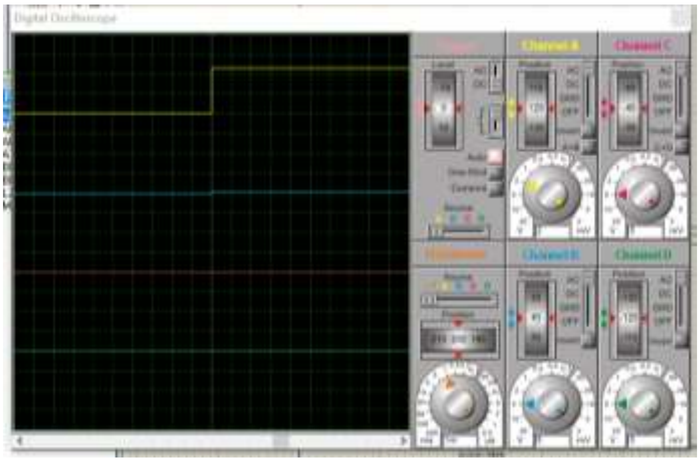

Fig.10. Simulation results for a slower control speed

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