

# Control of Electric Hoist Using Smartphone in Industrial Environment

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**Abstract:** This paper presents the implementation of electric hoist using a control operation based on Arduino board and Bluetooth module. It control the functions of movement and direction such as pick and release, up and down, and left or right with its relay-supporting dc voltage. Relay control on-off operation is effective to variation of rotation of the motor. The remote control is based on a smart phone application based on android platform with a Bluetooth connectivity used as a transmission as well as reception ports with Arduino module. With the introduction of Bluetooth, another dimension is aggregated, the possibility to connect to the devices wireless. The technology makes it possible to easily access the built-in user interfaces through portable devices but also to access the device data without the need for a physical connection.

**Keywords:** Android app, Arduino board, Bluetooth, electric power supply, industrial electric hoist model, and relay control circuit, smart phone.

## I. INTRODUCTION

The application of wireless controlled systems to industrial systems has grown in a spectacular way. One of the current challenges in this field is the application of the wireless technology, because it is looked for that the industrial-systems are flexible, so that they can be adapted easily to any process modifications. This would at low, in turn, the definition of generic modules that could be adapted to concrete problems. Then, it seems very important, the application of wireless control systems, so that without cables we have a much greater freedom to physically distribute the operations. In this system the Arduino Uno acts as the main controller and the Bluetooth module acts as the interface between the android application and the Arduino Module. The voice recognition app ;i.e 'AMR\_Voice' and the touch control app; 'BluControl' is readily available in the Android app market, which is specifically used in this process. When transmitting or receiving from rotating and moving machine parts, it is of great advantage to use wireless communication. Bluetooth in industry impose new requirements on the technology, while it at the same time opens up new and interesting possibilities for using wireless communications in industrial applications. The Bluetooth technology uses the short range radio communication to operate and hence has a short range of operation. In the current scenario, the operator has to operate the crane to its desired point by manually moving with it; hence the operator has to follow the crane on the work floor which in sometime is a great mess. So in this paper we are going to resolve this problem by introducing the combination of Bluetooth, Arduino and the android

platform in such a way that we can operate the crane wirelessly from a fixed point.

## II. LITERATURE SURVEY

As the technology is advancing the automation in various fields can easily be seen. For the physically handicapped or elder persons the mobility is quite a difficult task and they always need some assistance for doing various tasks. Smartphone of things deals with billions of intelligent objects which would be connected to sense & collect the data and also communicate with surrounding people using mobile, wireless and sensor technologies.

Objective of Smartphone of things is to manage and control physical objects around us in a more intelligent and meaningful manner. Also improve quality of life by providing cost effective living including safety, security and entertainment. Many types of cranes have been designed and produced by crane manufacturers. Each type is designed to handle different types of lifting and hoisting requirements Due to the central role of cranes in construction operations the crane in construction industries have cooperated in the development and use of structured methods and software tools like android apps.

Cranes should be located as far as possible in distance places to avoid interference and collisions, on the condition that all planned tasks can be performed by using Android app.

### III. SYSTEM ARCHITECTURE

#### 3.1 BLOCK DIAGRAM

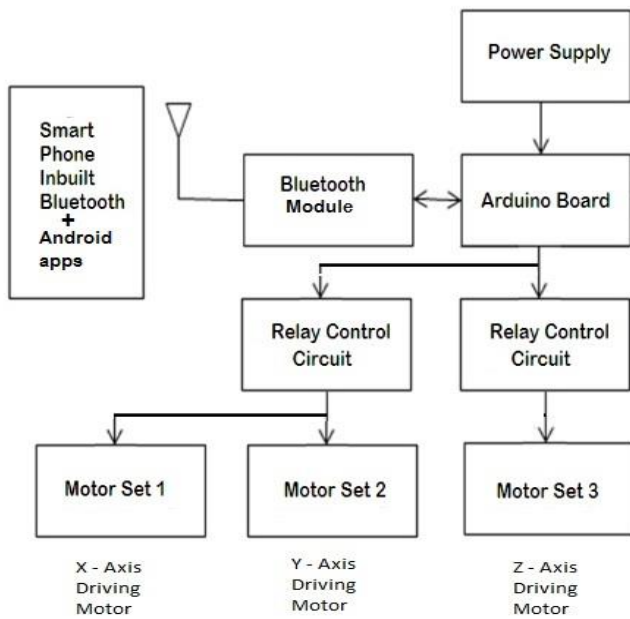


Fig. No.-3.1 Block diagram

#### 3.2 SYSTEM COMPONENTS

- DC gear motor
- Relay control circuit
- Arduino board
- Bluetooth module
- Power supply
- Smart phone
- Electric crane model

#### DC GEAR MOTOR

Center Shaft Economy Series DC Motor is high quality low cost DC geared motor. It has steel gears and pinions to ensure longer life and better wear and tear properties. The gears are fixed on hardened steel spindles polished to a mirror finish. The output shaft rotates in a plastic bushing. The whole assembly is covered with a plastic ring. Gearbox is sealed and lubricated with lithium grease and require no maintenance. The motor is screwed to gear box from inside. Although motor gives 60/30/10 RPM at 12V but motor runs smoothly from 4V to 12V and gives wide range of RPM, and torque. Tables below gives fairly good idea of the motor's performance in terms of RPM and no load current as a function of voltage and stall torque, stall current as a function of voltage. For compatible wheels refer to Wheels and Accessories product category. You can also mount this motor on the chassis using Motor Mount for Centre Shaft Economy Series DC Motor. For adding Position Encoder, refer to Encoder Kit for Center Shaft Economy Series DC Motor

Inside view of Center Shaft Economy Series DC Motor



Fig. No.-3.2. 1A DC gear motor

Motor Mounting Clamp with wheel

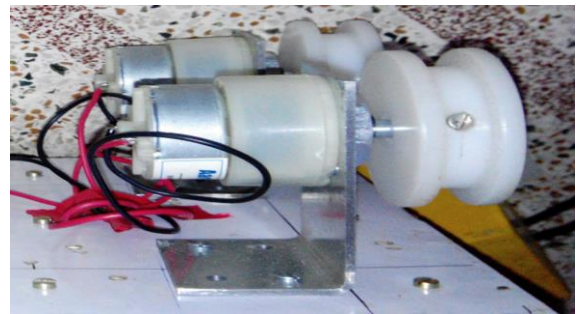


Fig. No.-4.2.1 B Motor Mounting Clamp with wheel

#### RELAY CONTROL CIRCUIT

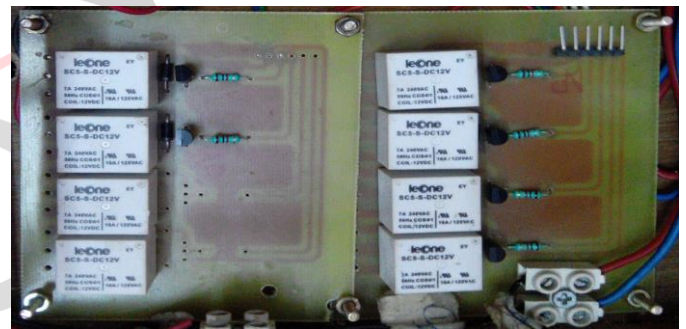


Fig. No.-4.2.2 Relay Control Circuit

#### ARDUINO BOARD

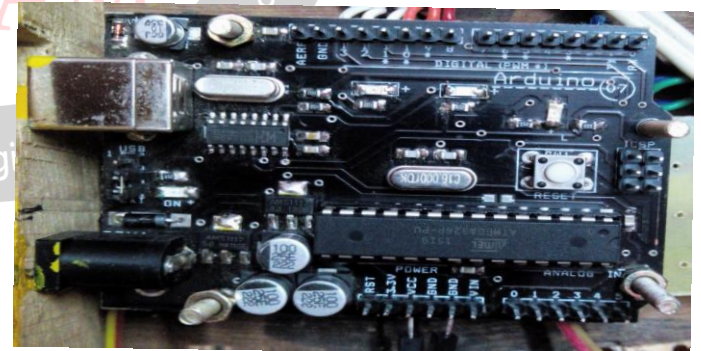


Fig. No.- 4.2.3A Arduino Uno Chipset

The Arduino Uno is a micro-controller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the micro-controller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Arduino is interfaced to the Bluetooth module which acts as the receptor which receives the commands transmitted from the smart phone.



As per the command transmitted and received by the module, the Arduino controls the counterpart which is here the electric crane motor.

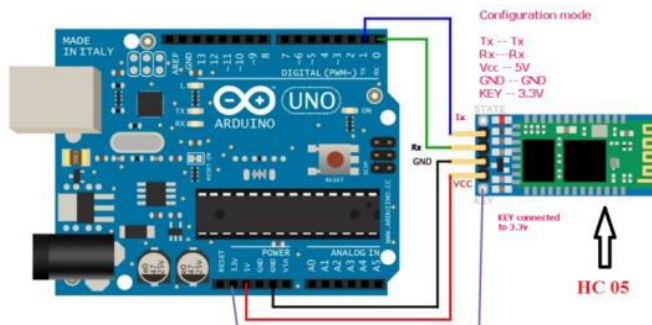


Fig. No.-4.2.3B Arduino and HC-05 Interface

- We are using the Arduino Uno micro-controller because it provides a multilevel scope for operation of multiple operands connected to it. It has an inbuilt Digital-Analog converter which is very helpful to run the electric motors through relays or even without it.

### BLUETOOTH MODULE

Bluetooth is a standard for short-range radio and personal area networks, developed by the Bluetooth Special Interest Group(SIG). The Bluetooth SIG is supported by a number of large multinational companies, This group of companies cooperate, to make the Bluetooth standard accepted and compatible worldwide. The Bluetooth standard uses the Industrial Scientific Medicine radio band (ISM) 2.45 GHz. The required and nominal range is 10m (transmit power 0 dBm, 1 mw) and an external power amplifier can be added which gives an extended range up to 100m (transmit power 20 dBm 100 mw). Bluetooth supports point to point and point to multi-point connections. The Bluetooth technology opens up new possibilities for using wireless communication in industrial environments. Wireless networks have some inherent advantages and limitations, that should be considered carefully when utilizing wireless technology in control systems. The main advantages are the no necessity of cables, the possibility of implement mobile applications and flexibility. In the other hand, the main disadvantages are the interference with other devices in the same radio frequency band and security.

#### Bluetooth module HC-05

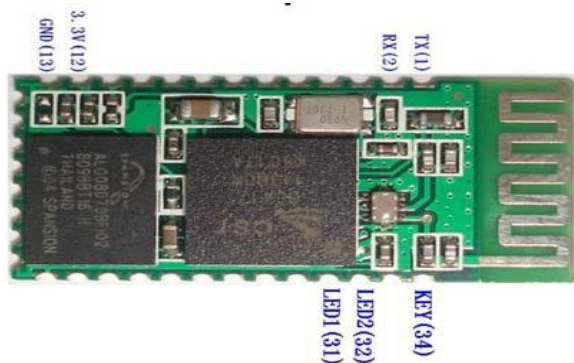


Fig. No.-4.2.4A Bluetooth Module HC-05

The Bluetooth module contains 4-pins generally. Two pins are used to provide power to the device, hence are connected to Vee and ground. The other two pins are used for transmission and reception of serial data. The "TX" (transmission) pin of the Bluetooth module is connected to a digital pin of micro-controller used for receiving the data and the "RX" (reception) pin of the Bluetooth module is connected to a digital pin of Arduino board used to transmit the data. This setup facilitates serial communication of data wirelessly. This module acts as a mediator which receives the signal from the smart phone and sends that signal to the Arduino Board

### Applications

- Wireless Telemetry
- Remote Data Logging
- Robotics
- Sensor Networks
- Remote Programming

### Specifications

- Bluetooth protocol v2.0
- Range 10 meters
- Frequency: 2.4 GHz ISM
- Modulation: GFSK
- Transmit power: 4dBm
- Rate: 2.1Mbps(Max) /160kbps(Async); 1Mbps(Sync)
- Authentication & Encryption
- Module only Power Supply: +3.3 VDC 50mA
- Operating Temperate: -20C to +55 C

### POWER SUPPLY

Power supply is a supply of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. A power supply may include a power distribution system as well as primary or secondary sources of energy such as Conversion of one form of electrical power to another desired form and voltage, typically involving converting AC line voltage to a well-regulated lower-voltage DC for electronic devices. Low voltage, low power DC power supply units are commonly integrated with the devices they supply, such as computers and household electronics.

#### Regulated Power supply

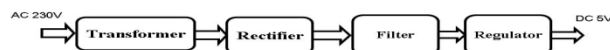


Fig. No.-4.2.5 Regulated Power Supply

### LM7805 VOLTAGE REGULATOR

The MC78XX/LM78XX/MC78XXA series of three terminal positive regulators are available in the TO-220/D-PAK package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be

used with external components to obtain adjustable voltages and currents.

### Features

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection.

### IV. CIRCUIT DESIGN

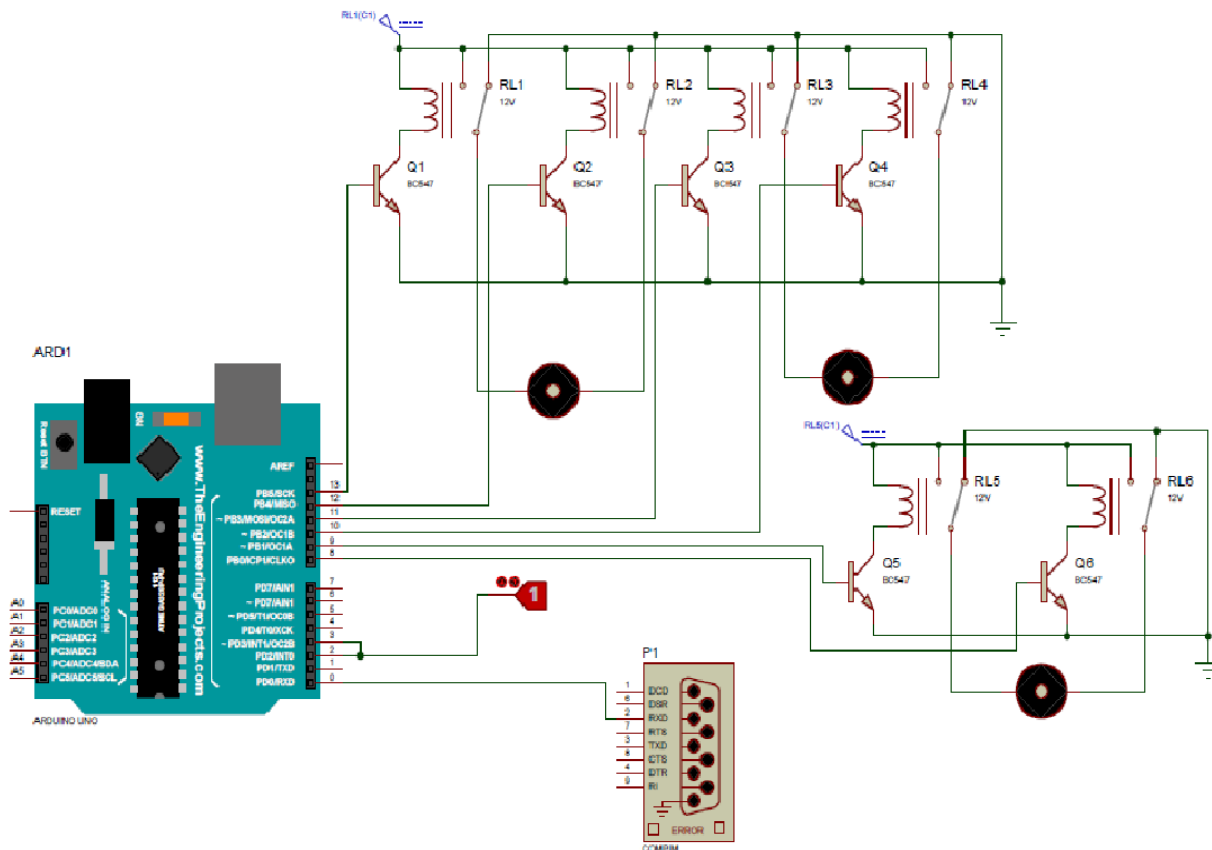


Fig. No.-5.1 Circuit Design

### V. RESULT ANALYSIS

#### BluControl

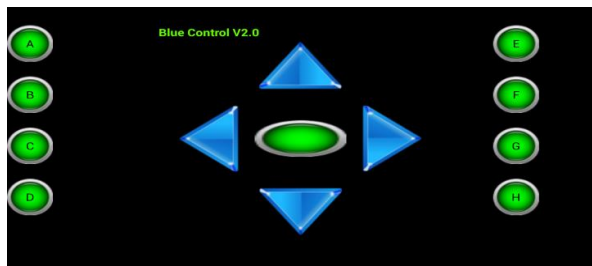


Fig. No.-4.2.6D BluControl Application

It is another Android application that is also readily available on the GOOGLE Play store. It serves as a touch control application. As shown in Figure a total number of six(6) direction arrow are controlled using this application.

It works on the similar principle as depicted above; the only difference is that on touching the control relays on the app, converts the action in to motor rotation. It is linked with Bluetooth of the Android mobile to the Arduino serial buffer via Bluetooth Module HC-05. After obtaining the various motor rotation, the system is so designed that the control strategy for each of the moving action may be actuated using the relays.

S.No	Touch Command	Action Performed
1.	Key D	Catch the weight
2.	Key H	Drop the weight
3.	Right arrow	Move to right
4.	Left arrow	Move to left
5.	Up arrow	Move to forward
6.	Down arrow	Move to backward

Table 3. Touch Commands for the Applications

For using the BluControl for touch control the following steps follows:-

**Step1:** Open the BluControl Application and tap on the Connect button which will connect our application to the HC-05 as shown in Figure 5.2.



Fig. No.-4.2.6E Tap Connect to make the connection with HC-05

**Step2:** Once the module is connected tap on the Arrow button for the various direction to operate the crane.

**SMARTPHONE**

**ANDROID APPLICATIONS**

The 80% of the smart phone runs on the android platform and also the android is one of the best customizable platform that can be used for many useful purposes. Hence we are using two of the android application ; ‘AMR\_Voice’ & ‘BluControl’ respectively for the wireless operation of the crane. The ‘AMR\_Voice’ application is for the Voice control whereas the ‘BluControl’ is for the touch control.

**AMR Voice**

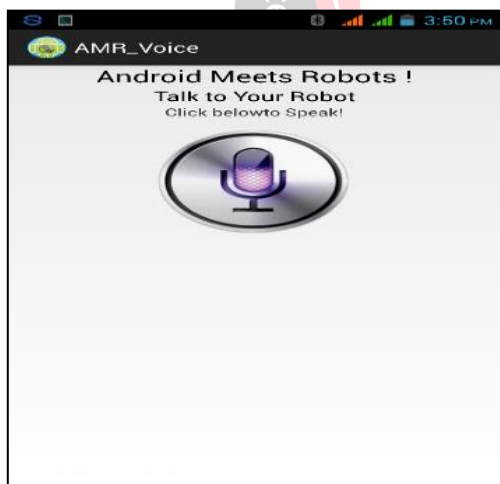


Fig. No.-4.2.6A AMR Voice App

This is a voice -controlled application. As shown in the figure on tapping the microphone (mic) icon, the voice commands is sent for controlling various appliances.

First step is to tap the mic icon and say something. The speech commands get converted to text. The converted text is sent over the Bluetooth of the Android mobile to the serial buffer of Arduino via Bluetooth module HC-05. From the serial buffer data retrieved for the voice commands. By using Arduino Uno programmer the data strings are compared with look up table and generated an actuation signal for the relays to control various appliances

S.No	Voice Command	Action Performed
1.	Pick	Catch the weight
2.	Release	Drop the weight
3.	Right	Move to right
4.	Left	Move to left
5.	Up	Move to forward
6.	Down	Move to backward

Table 2. Voice Commands for the Applications

**AMR\_Voice**

For using the voice commands the following steps are as follows:-

**Step1:** Open the AMR\_Voice application and click on the “Connect Robot” as shown in Figure 5.1.1 to connect the application to the Bluetooth module HC-05.

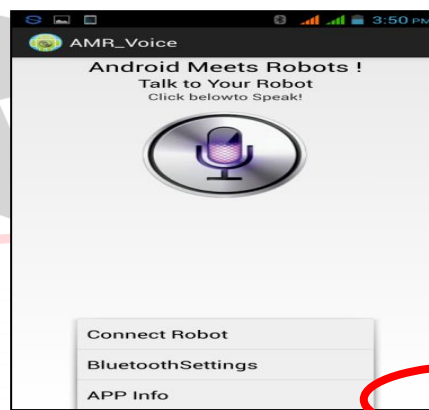


Fig. No.-4.2.6B Option to connect the app with HC-05

**Step2:** Once the module is connected tap on the mic icon of the app as shown in Figure 5.1.2 and say the command.

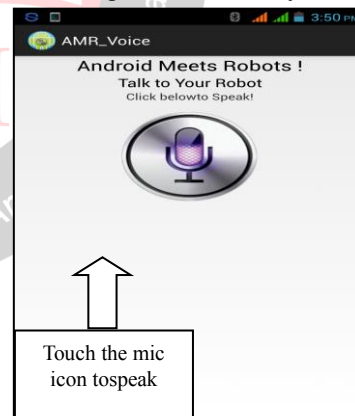


Fig. No.-4.2.6C Touch the mic icon to speak

**Step3:** Once we speak the app converts the voice to text using Google voice services that go over the phone Bluetooth to the Bluetooth module HC-05.

**Step4:** From the serial buffer we get the stored text, and we use it as the control commands for various purposes.

**ADVANTAGES**

- The most significant benefit is improved safety.



- A good choice for many situations, remote crane controls are ideal for higher risk applications such as hot metal and steel mill cranes and multiple crane operations.
- When the operator works from the floor with remote controls, the second position isn't necessary.
- It gives mobility to the operator.
- It is easy to understand and operate to the operator, not required skilled person.

## VI. CONCLUSION

Bluetooth technology is interesting in industrial application, especially due to the flexibility, low cost and high-speed data transfer. A study of the Bluetooth application in an industrial environment has been presented in this work. The voice and touch control for the home automation system are implemented and has been tested successfully. While using the voice commands, care must be taken to have a noise free environment.

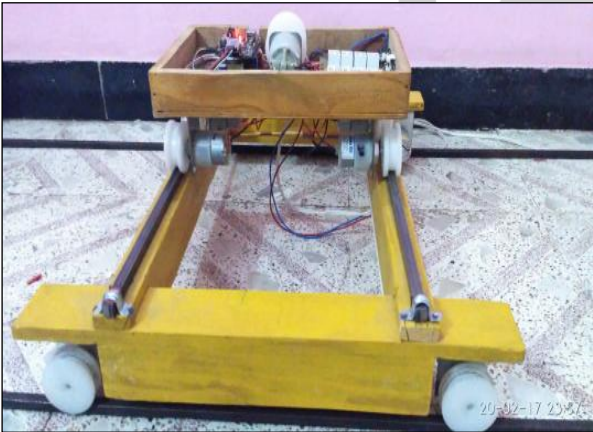


Figure 5.5 Hoist model side view

The combination of Bluetooth Arduino and android has brought up a best way or a smart way to operate the hoist wireless from a remote location. It's main advantages is that it helps in hassle free operation of hoist and helps in keeping the work floor sheets free. This system has the scope for modifications, and more devices can be added and further research can lead to a smarter control system. As a last concluding point is to say that Bluetooth network has the great potential to offer a smart wireless transmission industrial environmental and with the help of additional error correction scheme and studies in real time and fault occurred can increase the applicability.

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