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# AUTOMATION USING ROBOTIC ARM IN ROTOR PACKAGING

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***ABSTRACT:*** **Till date automation in small and medium scale industries has not enjoyed the same rate of growth as in other information technology sectors, lagging significantly behind automation in large batch production .The use of LabVIEW interfaced with micro-controller in controlling a robotic arm is a latest technique which is being implemented in this project. In medium scale industries packaging of rotors is done manually. This Process is time consuming and also requires manpower. Through this project our efforts are to increase the efficiency by building an automated system which would employ and also reduces manpower. It involves the use of a robotic arm which would identify the rotors positioning, pick it and then place it in the desired location. With the use of this system the process of packaging can be done effectively without any manpower and also does not require constant monitoring and guidance. The DC gear motors are used in actuating the robotic arm. Electromagnetic gripper is employed at the end of the arm which picks and places the helical rotor of weight 1.5 kg in the desired position for packaging and this mechanism is automated and controlled using LabVIEW. The complete set up is compact and versatile.**

**Keywords: LabVIEW, Automation, Electromagnetic Gripper, Helical rotor, Robotic arm.**

## I.INTRODUCTION

In pump manufacturing industries helical rotors which belong to a special variety are being used and the packing of these rotors is done manually. In our project we have put an effort to implement a completely automated system for the rotor packaging process by using a robotic arm [9]. The main process is controlled and automated using LabVIEW [10]. The mechanical setup consists of DC gear motors, Electromagnetic grippers and inductive proximity sensors for the overall functionality of the pick and place robotic arm setup. The mechanism involved here is picking and placing the helical rotor which weighs 1.5kgs by means of an electromagnetic gripper; this is done automatically without any human constraints.

The previous process involves the packaging of helical rotor which was done manually it required more manpower and also consumed large amount of time. By implementing our project the huge amount of weight 1.5kgs can easily be picked, placed and packed in the desired location at a very low cost by automating the whole process.

The paper is organized as follows: Section 1 is the introduction of the Rotor Packaging automation. Section 2 is the Block diagram. Section 3 is the block diagram description. Section 4 includes the role of the LabVIEW. Section 5 comprises of results. Section 6 involves Conclusion and future work.

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## II.BLOCK DIAGRAM

This section describes the hardware of our project. The block diagram of the project is shown in Fig.1.It consists of various blocks whose descriptions are as follows.

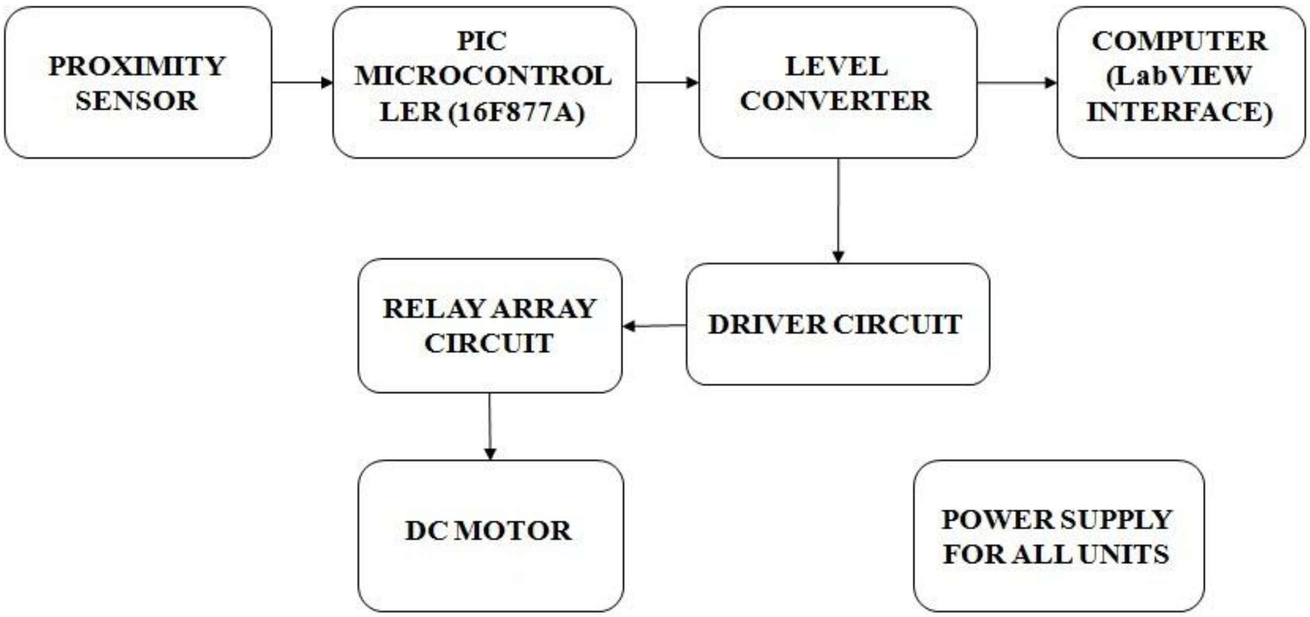


Fig.1 Block diagram of overall setup

## III.BLOCK DIAGRAM DESCRIPTION

***A. Power Supply Unit***

The input power supply 230V, 50Hz AC is given to step down transformer, where it is stepped down to12V. This step down voltage signal +12V is given to the bridge rectifier which converts AC to DC voltage [1-5]. The output DC voltage is regulated by the voltage regulators to get regulated voltages like +5V.

***B. Inductive Proximity Sensor***

Inductive Proximity Sensor is an electronic proximity sensor. It detects metallic objects without touching them. The term smart sensors refers to sensors which contain both sensing and signal processing capabilities with objectives ranging from simple viewing to sophisticated remote sensing[1]. The inductive proximity sensor which is placed near the setup is used to sense the object which is to be picked by the robotic arm. The inductive proximity sensor is used is of diffused type sensor [9]. It can sense a range of upto 50mm to 300mm.It needs a voltage supply of 24V DC.

***C. PIC Micro-Controller***

A microcontroller is a complete microprocessor system built on a single IC. Microcontrollers were developed to meet a need for microprocessors to be put into low cost products. Building a complete microprocessor system on a single chip substantially reduces the cost of building simple products, which use the microprocessor's power to implement their function, because the microprocessor is a natural way to implement many products. The microcontroller contains full implementation of a standard microprocessor, ROM, RAM, and I/O, clock, timers and also serial ports. Microcontroller also called system on a chip or single chip microprocessor system or computer on a chip.

PIC 16F877A microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS, complementary metal oxide semiconductor that uses separate bus for instruction and data allowing simultaneous access of program and data memory. The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has more immunity to noise than other fabrication techniques.

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Core features of PIC 16F877A microcontroller are

- High-performance RISC CPU
- Only 35 single word instructions to learn
- All single cycle instructions except for program branches which are two cycle
- Operating speed: DC - 20 MHz clock input ,DC - 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory

***D. Level Converter***

The level converter is used for interfacing the PC and the controller and also to convert one logic to another. The controller used here is MAX232 it is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors [2]. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case.

The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V. When a MAX232 IC receives a TTL level to convert, it changes a TTL Logic 0 to between +3 and +15V, and changes TTL Logic 1 to between -3 to -15V, and vice versa for converting from RS232 to TTL. The RS232 Data Transmission voltages at a certain logic state are opposite from the RS232 Control Line voltages at the same logic state.

***E. Driver Circuit***

The driver circuit is used to convert low level TTL signal to high output current or voltage. The driver used here is ULN2803 which is an Integrated Circuit chip with a High Voltage/High Current Darlington Transistor Array. It allows you to interface TTL signals with higher voltage/current loads [8]. In English, the chip takes low level signals and acts as a relay of sorts itself, switching on or off a higher level signal on the opposite side. A TTL signal operates from 0-5V, with everything between 0.0 and 0.8V considered "low" or off, and 2.2 to 5.0V being considered high or on. The maximum power available on a TTL signal depends on the type, but generally does not exceed 25mW, so it is not useful for providing power to something like a relay coil. Computers and other electronic devices frequently generate TTL signals. On the output side the ULN2803 is generally rated at 50V/500mA, so if can operate small loads directly. Alternatively, it is frequently used to power the coil of one or more relays, which in turn allow even higher voltages/currents to be controlled by the low level signal.

***F. Relay Array Circuit***

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw switch contacts [3-6]. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification. Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. The relay's switch connections are usually labeled COM, NC and NO:

- COM = Common, always connect to this and it is the moving part of the switch.
- NC = Normally Closed, COM is connected to this when the relay coil is off.
- NO = Normally Open, COM is connected to this when the relay coil is on.
- Connect to COM and NO if you want the switched circuit to be on when the relay coil is on.

Connect to COM and NC if you want the switched circuit to be on when the relay coil is off.

***G. DC motor***

DC motors are part of the electric motors using DC power as energy source. These devices transform electrical energy into mechanical energy. The basic principle of DC motors is same as electric motors in general, the magnetic interaction between the rotor and the stator that will generate spin.30RPM 12V DC geared motors for robotics applications [2].Easy to use and available in standard size. Nuts and threads on shaft to easily connect and internal threaded shaft for easily connecting it to wheel. The Features of DC motor are

- 30RPM 12V DC motors with Gearbox

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- 4mm shaft diameter with internal hole
- 125gm weight and 2kgcm torque
- No-load current = 60 mA(Max), Load current = 300 mA(Max)

## IV.ROLE OF LabVIEW

### *A. Introduction to LabVIEW*

LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a development environment based on graphical programming [4] [7]. It is a graphical programming language that uses icons instead of lines of text to create applications. In contrast to text based programming languages, where instructions determine program execution, LabVIEW dataflow programming, where data determine execution. LabVIEW empowers to build solutions for scientific and engineering systems. LabVIEW gives flexibility and performance of a powerful programming language without the associated difficulty and complexity.

### *B. Front Panel*

The front panel is the user interface of the VI [10]. We build the front panel with controls and indicators, which are the interactive input and output terminals of the VI respectively. Controls are knobs, push buttons, dials, and other input devices. Indicators are graphs, LEDs and other displays. Controls simulate instrument input devices and supply data to the block diagram of the VI. Indicators simulate instrument output devices and display data the back panel acquires or generates.

### *C. Control Palette*

The various sub palettes used are,

- Numeric controls sub palette: numeric controls are included in the front panel for user interface to change the gain values in the design of the PID controller.
- Graph sub-palette: graph indicators are used for generating the response curves of the system.

### *D. Function Palette*

The function palette is available only on the block diagram. The functions palette contains the VIs and functions used to build the block diagram.

- Select window >> Show Function Palette or Right-Click the block diagram workspace to display the Function palette .The Functions Palette can be placed anywhere on screen.
- Different hardware and software components can make the virtual instrumentation system. There is wide variety of hardware components can be used to monitor or control a process or test a device.

### *E. Tools Palette*

The tools palette used in front panel and block diagram.

- The Tool palette is available on the front panel and block diagram. A tool is a special operating mode of the mouse cursor. While selecting a tool, the cursor icon changes to the tool icon.
- Use the tools to operate and modify front panel and block diagram objects. Select Window>> show Tools palette to display the Tools palette and it can be placed anywhere on the screen.

### *F. Block Diagram*

After building the front panel, add code using graphical representation of control with front panel objects. The block diagram contains this graphical source code. Front panel objects appear as terminals from the block diagram. Every control or indicator on the front panel has a corresponding terminal on the block diagram. Additionally, the block diagram contains functions and structures from build-in LabVIEW VI libraries. Wires connect each of the nodes on the block diagram, including control and indicator terminal, function, and structure.

### *G. Interfacing*

RS232 is interfaced with PIC microcontroller series 16F877A which acts as interface between mechanical setup (drivers) and LabVIEW. LabVIEW acts as a controller for the entire process and interfacing mechanism shown below fig.2

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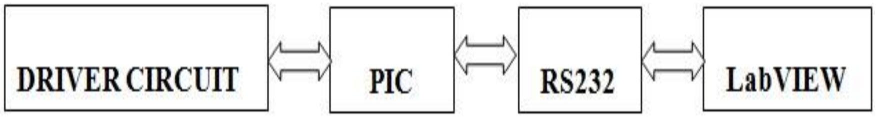


Fig.2 Interfacing Mechanism

## V.RESULTS

The Front panel and Block Diagram of LabVIEW is shown below

### *A. Front Panel*

The **fig3.** Shows the front panel of the LabVIEW, where the process can be initiated, controlled, terminated and indicates the position of Robotic Arm. The Front Panel also alerts and indicates the error in circuit connection.

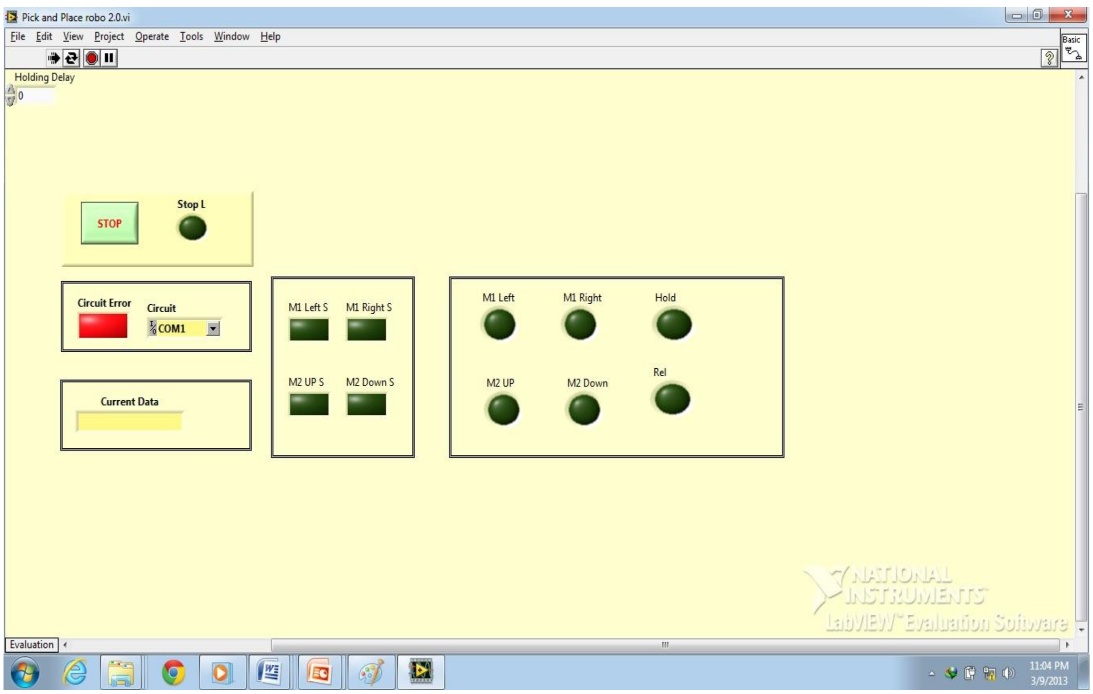


Fig.3 Front Panel of the Process

### *B. Block Diagram*

The Fig4. shows the Block diagram of LabVIEW. The VI shown in the diagram is the overall control mechanism of automated robotic arm.

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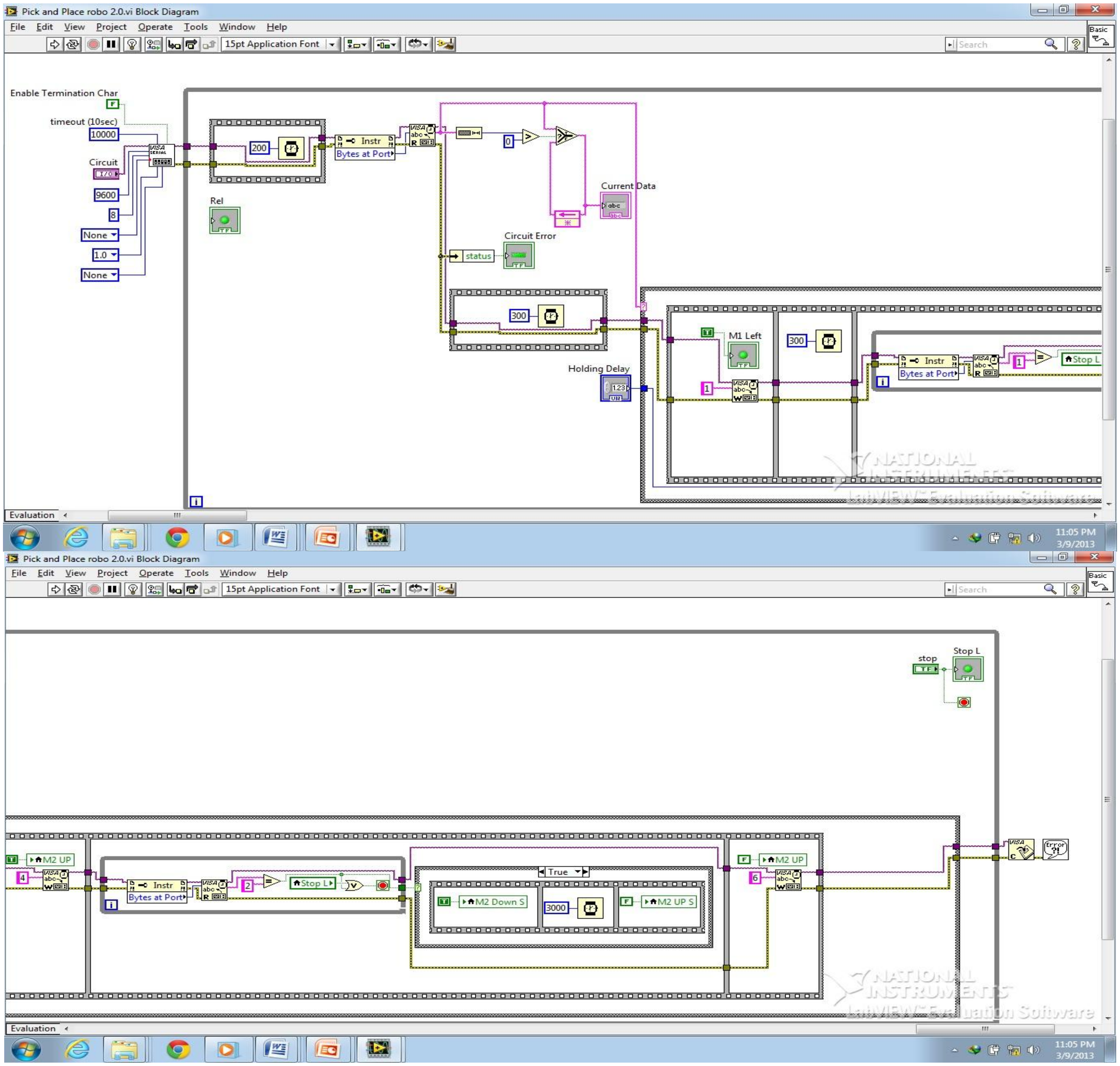


Fig.4 VI program of the overall process

### *C. Mechanical Setup*

The robotic arm setup is shown in the below figure.

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Fig.5 Mechanical setup

### *D. Electrical Setup*

The electrical setup of the overall setup is given below

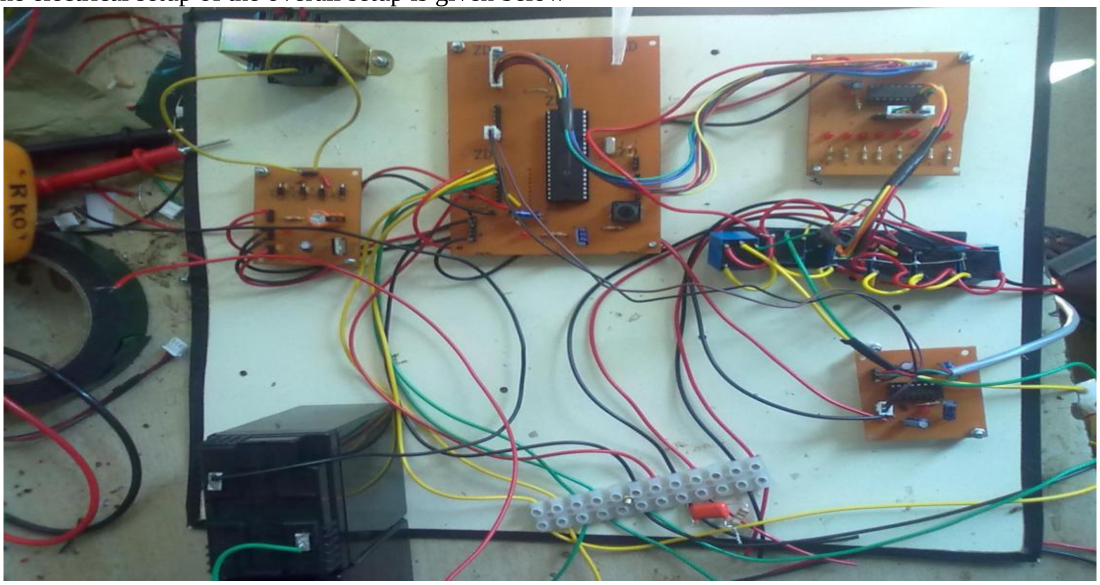

Fig.6 Electrical setup

## VI.CONCLUSION AND FUTURE WORK

Thus by using LabVIEW based automated system, the pick and place robotic arm was accomplished. LabVIEW serves the purpose of easy programming and has high flexibility. The robotic arm is very flexible so that the operation can be changed as programmed by LabVIEW. In future the end effectors can be changed into any form such as paint gun, welding electrode etc. to suit other applications

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Prof.G.Gopu received his Bachelor's Degree in Electrical and Electronics Engineering in 1996 from Annamalai University,Chidambaram and Master's Degree in Biomedical Signal processing and Instrumentation in 2002 from SASTRA University, Thanjavur. He is currently working as an Professor in the Department of Biomedical Engineering, Sri Ramakrishna Engineering College, Coimbatore. His areas of specialization are Biomedical Engineering, Electrical measurement and Instrumentation, Electronics Instrumentation, Industrial Instrumentation and Electronic Circuits. He has published 9 International Journal papers and 20 papers in National and International conferences. He is life member of various professional bodies like Institute of Electrical and Electronics Engineers (IEEE), Indian Society for Technical Education (ISTE), Biomedical Engineering Society of India (BMESI) and Institution of Electronics and Telecommunication Engineers (IETE).

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