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# Intelligent Bottle Filling Pick and Place Robot-A Review

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**Abstract:** The pick and place robot will be designed so that User are going filled the liquid in bottle according to volume occupied in the bottle and after filling the liquid robot will do pick and place operation by mechanical devices such as gripper and robotic arm and filled the liquid by solenoid valve .The design will be on a low-cost robot platform for intelligent pick up and place up the things. There is establishment of both wireless communication between the mobile Robot and the remote Base Station, and serial communication between the remote Base Station and the GUI Application. The Base Station requires the serial communication with the GUI Application and also needs to be hardwired with the radio packet controller,PL2303 for wireless control. Our aim is to be able to command and control the Robot wirelessly by the GUI Application. The main task of this project is two parts: (1) to program the ATmega16 microcontroller on both the Base Station and the Robot interfaced to the radio packet controller module which would enable us to wirelessly control the Robot; (2) to program the GUI Application which would enable us to serially control the Base Station. Theoretical system limitation for the packet transmission is evaluated and analyzed. The wireless parts were evaluated with CRC error checking. As a result, we achieved control both wireless communication between the mobile Robot and the remote Base Station, and serial communication between the remote Base Station and the GUI Application. This level of completely was successfully tested on groups at up to four Robots. Hence the wireless communication and the serial communication were successful in the downlink.

**Keywords:** GUI graphics user interface, CRC cyclic redundancy.

## 1. INTRODUCTION

### 1.1 INTRODUCTION TO ROBOTICS

Robotics researchers regularly endow robot platforms with new capabilities that increase the breadth of potential applications and push the boundaries of autonomy. In contrast, industrial automation is driven by a pragmatism dictated by the need to optimize throughput and reliability. The hope of both is that, as multi-purpose robotic platforms become more capable, they will be able to take over an increasing fraction of the tasks currently handled by application specific, fixed installation automation, thereby granting all applications greater levels of modularity and adapt ability which is expressed in [1]. We are now seeing an acceleration of the rate at which research robotics feeds into engineering practice. In this project we are trying to establish both wireless communication between the mobile Robot and the remote Base Station, and serial communication between the remote Base Station and the GUI Application. The Base Station requires the serial communication with the GUI Application and also needs to be hardwired with the radio packet controller, FRPC2 for wireless control. Our aim is to be able to command and control the Robot wirelessly by the GUI Application as given in[3]. The main task of this project is two parts: (1) to program the AVR microcontroller on both the Base Station and the Robot interfaced to the radio packet controller module which would enable us to wirelessly control the Robot; (2) to program the GUI Application which would enable us to serially control the Base Station.

Theoretical system limitation for the packet transmission is evaluated and analyzed. We tested packet stress to the wireless module while varying the number of Robots and the payload data. The wireless parts were evaluated with CRC error checking. As a result, we achieved control both wireless communication between the mobile Robot and the remote Base Station, and serial communication between the remote Base Station and the GUI Application. This level of completely was successfully tested on groups at up to four Robots. Hence the wireless communication and the serial communication were successful in the downlink.

A robot may appear like a human being or an animal or a simple electro-mechanical device. A robot may act under the direct control of a human (e.g. the robotic arm of the space shuttle) or autonomously under the control of a programmed computer. Robots may be used to perform tasks that are too dangerous or difficult for humans to implement directly (e.g. nuclear waste cleanup) or may be used to automate repetitive tasks that can be performed more cheaply by a robot than by the employment of a human (e.g. automobile production) or may be used to automate mindless repetitive tasks that should be performed with more precision by a robot than by a human (material handling, material transfer applications, machine

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loading and unloading, processing operations, assembly and inspection).The last two decades have witnessed a significant advance in the field of robots application. Many more applications are expected to appear in space exploration, battlefield and in various actives of daily life in the coming years.

A robot is a mechanical device that performs automated tasks and movements, according to either pre-defined program or a set of general guidelines and direct human supervision. These tasks either replace or enhance human work, such as in manufacturing, contraction or manipulation of heavy or hazardous material. Robot is an integral part in automating the flexible manufacturing system that one greatly in demand these days. Robots are now more than a machine, as robots have become the solution of the future as cost labor wages and customers demand. Even though the cost of acquiring robotic system is quite expensive but as today's rapid development and a very high demand in quality with IS0 standards, human are no longer capable of such demands. Research and development of future robots is moving at a very rapid pace due to the constantly improving and upgrading of the quality standards of products. In this project we are going to perform three main actions the robot is going to pick operation to place operation and to filled the quantity of liquid according to user.

## 2. LITERATURE REVIEW

### 2.1 History of robot

The field of robotics has its origins in science fictions. It has been in English since 1923 when the Czech writer Karel Capek's play R.U.R. was translated into English and presented in London and New York. R.U.R., published in 1921, The word robot comes from the Czech word "robota" means forced labor in 1920. It took another 40 years before the modern technology of industrial robotics began. The Slavic root behind robota is orb-, from the Indo-European root orbh, referring to separation from one's group or passing out of one sphere of ownership into another. Czech robota is also similar to another German derivative of this root, namely Arbeit, "work". Arbeit may be descended from a word that meant "slave labor," and later generalized to just "labor."Today, robots are highly automated mechanical manipulators controlled by computers used in [3]. A robot may appear like a human being or an animal or a simple electro-mechanical device.

A robot may act under the direct control of a human (e.g. the robotic arm of the space shuttle) or autonomously under the control of a programmed computer. Robots may be used to perform tasks that are too dangerous or difficult for humans to implement directly (e.g. nuclear waste cleanup) or may be used to automate repetitive tasks that can be performed more cheaply by a robot than by the employment of a human (e.g. automobile production) or may be used to automate mindless repetitive tasks that should be performed with more precision by a robot than by a human (material handling, material transfer applications, machine loading and unloading, processing operations, assembly and inspection).

The last two decades have witnessed a significant advance in the field of robots application. Many more applications are expected to appear in space exploration, battlefield and in various actives of daily life in the coming years. A robot is a mechanical device that performs automated tasks and movements, according to either pre-defined program or a set of general guidelines and direct human supervision. These tasks either replace or enhance human work, such as in manufacturing, contraction or manipulation of heavy or hazardous material. Robot is an integral part in automating the flexible manufacturing system that one greatly in demand these day.

### 2.2 Features of Proposed Pickand Place Robot

- User defined input.
- Mobile robo(upto 30m)
- Wireless Controlled from PC
- Implementation will be done by using embedded in C basic,so easy to handle among common people.

## 3. DEVELOPMENT OF THE SYSTEM

### 3.1 Background

The various factors to be considered while designing of pick and place robots are been discussed as follows. The factors are all important while designing procedure of the robot.

3.1.1 Controls

The mechanical structure of a robot must be controlled to perform tasks. The control of a robot involves three distinct phases - perception, processing, and action. Sensors give information about the environment or the robot itself (e.g. the position of its joints or its end effector). This information is then processed to calculate the appropriate signals to the actuators (motors) which move the mechanical. The processing phase can range in complexity. At a reactive level, it may translate raw sensor information directly into actuator commands. Sensor fusion may first be used to estimate parameters of interest (e.g. the position of the robot's gripper) from noisy sensor data. An immediate task (such as moving the gripper in a certain direction) is inferred from these estimates. Techniques from control theory convert the task into commands that drive the actuators which is given in[5]. At longer time scales or with more sophisticated tasks, the robot may need to build and reason with a "cognitive" model. Cognitive models try to represent the robot, the world, and how they interact. Pattern recognition and computer vision can be used to track objects. Mapping techniques can be used to build maps of the world. Finally, motion planning and other artificial intelligence techniques may be used to figure out how to act. For example, a planner may figure out how to achieve a task without hitting obstacles, falling over, etc.


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3.1.2 Autonomy Levels

Control systems may also have varying levels of autonomy.

1. Direct interaction is used for hap tic or tale-operated devices, and the human has nearly complete control over the robot's motion.
2. Operator-assist modes have the operator commanding medium-to-high-level tasks, with the robot automatically figuring out how to achieve them.
3. An autonomous robot may go for extended periods of time without human interaction. Higher levels of autonomy do not necessarily require more complex cognitive capabilities. For example, robots in assembly plants are completely autonomous, but operate in a fixed pattern. Another classification takes into account the interaction between human control and the machine motions.

1. Teleportation: - A human controls each movement; each machine actuator change is specified by the operator.
2. Supervisory: - A human specifies general moves or position changes and the machine decides specific movements of its actuators.
3. Task-level autonomy: - The operator specifies only the task and the robot manages itself to complete it.
4. Full autonomy: - The machine will create and complete all its tasks without human interaction.

3.1.3 Degree of Freedom

The number of DOF that a manipulator possesses is the number of independent position variables that would have to be specified in order to locate all parts of the mechanism; it refers to the number of different ways in which a robot arm can move in the particular direction. In the case of typical industrial robots, because a manipulator is usually an open kinematic chain, and because each joint position is usually defined with a single variable, the number of joints equals the number of degrees of freedom. We can use the arm to get the idea of degrees of freedom. Keeping the arm straight,moving it from shoulder, we can move in three ways. Up-and-down movement is called pitch. Movement to the right and left is called yaw. By rotating the whole arm as screwdriver is called roll. The shoulder has three degrees of freedom. They are pitch, yaw and roll. Moving the arm from the elbow only, holding the shoulder in same position constantly. The elbow joint has the equivalent of pitch in shoulder joint, thus the elbow has one degree of freedom. Now moving the wrist straight and motion less, we can bend the wrist and up and down, side to side and it can also twist a little. The lower arm has the same three degrees of freedom. Thus the robot has totally seven degrees of freedom. Three degrees of freedom are sufficient to bring the end of a robot arm to any point within its workspace, or work envelope in three dimensions as in [1].

**3.2 Block Diagram of the Proposed System**

From the below proposed diagram for intelligent pick and place shown in Fig3.1, the robot first detects the how much quantity required to fill the bottle by weight sensor that quantity is showed on PC through MATLAB window. User will give the input and soloniodal pump it will filled liquid in the bottle. Now gripper is connected to robotic arm that pick the bottle according to programming of Microcontroller and place to desired location. Once work will completed it will report through RF module that work completed ready to do another work we can detect the robot position and command through PC.

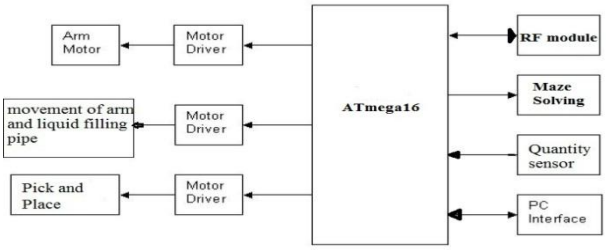


Fig 3.1 Proposed block diagram for intelligent pick and place robot.

- Input and output devices: PC and RF module.
- Input device: Quantity Sensor.
- Mechanical devices: Gripper, Robotic arm, solenoidal pump.

**3.3 Component Specification**

3.3.1 RF module

RF modem can be used for applications that need two way wireless data transmission.The Fig3.2 shows RF module design. It features adjustable data rate and reliable transmission distance. The communication protocol is self-controlled and completely transparent to user interface. The module can be embedded to your current design so that wireless communication can be set up easily. This module works in half-duplex mode. Means it can either transmit or receive but not both at same time. After each transmission, module will be switched to receiver mode automatically. The LED for TX and RX indicates whether IC is currently receiving or transmitting data. The data sent is checked for CRC error if any. If chip is transmitting and any data is input to transmit, it will be kept in buffer for next transmission cycle. It has internal 64 bytes of buffer for incoming data. When you power on the unit, the TX LED will briefly blink indicating that initialization is complete and it is ready to use. The RX LED is directly on TX OUT pin to indicate that actual data is received and it is sent to output pin.


Fig 3.2 RF module

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Specifications:
• Automatic switching between TX and RX mode.
• FSK technology, half duplex mode, robust to interference.
• 2.4 GHz band, no need to apply frequency usage license.
• Protocol translation is self controlled, easy to use.
• High sensitivity, reliable transmission range.
• Standard UART interface, TTL(3-5V) logic level.
• Stable, small size, easier mounting.
• Error checking(CRC) of data in built.

3.3.2 ATmega16L

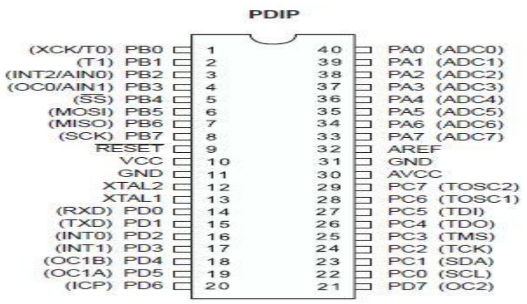


Fig 3.3 Pin diagram for ic ATmega16L

Specifications:
• High-performance, Low-power AVR® 8-bit Microcontroller
• Advanced RISC Architecture
– 131 Powerful Instructions – Most Single-clock Cycle Execution
– 32 x 8 General Purpose Working Registers
– Fully Static Operation
– Up to 16 MIPS Throughput at 16 MHz
– On-chip 2-cycle Multiplier
• Nonvolatile Program and Data Memories
– 16K Bytes of In-System Self-Programmable Flash
Endurance: 10,000 Write/Erase Cycles
– 1K Byte Internal SRAM
– Programming Lock for Software Security
• JTAG (IEEE std. 1149.1 Compliant) Interface
– Boundary-scan Capabilities According to the JTAG Standard
– Extensive On-chip Debug Support
– Programming of Flash, EEPROM, Fuses, and Lock Bits through the JTAG Interface
• Peripheral Features
– Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes
– One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture

3.3.3 Weight sensor (Subminiature Load Cell)
Model 13 (compression only) subminiature load cell is designed to measure load ranges from 150 g to 1000 lb. With subminiature dimensions, including diameters from 0.38 in to 0.75 in and heights of 0.13 in to 0.25 in, these units are easily incorporated into systems having limited space. Model 13 combines high frequency response and low deflection to achieve a combined non-linearity and hysteresis of 0.25 % to 0.5 % full scale. A balance module is included in the load cell's lead wire cable for temperature compensation and should not be removed. Fig 3.4 shows the weight sensor.

Fig 3.4 Weight Sensor

FEATURES
• 150 g to 1000 lb
• 0.7 % accuracy
• mV/V output
• Subminiature design
• Single diaphragm construction

3.3.4 Gripper
The RG2 gripper is a flexible electric gripper specially designed for robots from Universal Robots. The long stroke allows the gripper to handle a variety of object sizes. Adjusting the gripping force allows the gripper to handle both delicate and heavy object. The standard fingers can be used with many different object. It is also possible to fit custom fingers. The installation complexity is minimal as the cable attaches directly onto any robot from Universal Robots. All configurations of the gripper is controlled from the Universal Robots software. Gripper is shown in Fig 3.5.

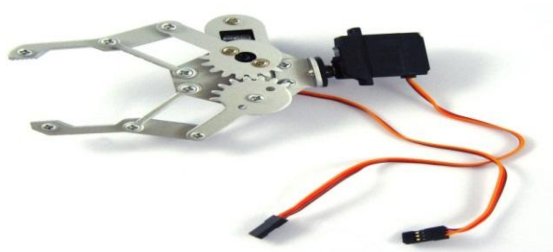

Fig3.5 Gripper

FEATURES
• Plug n' play Mount, connect, run script - Automate
• Simple programming As simple as setting variables.
• Failsafe operation In case of power loss the gripping force is maintained.
• Force and Width detection Uses I/O's to give feedback on reached force or Width.
• Analog width feedback One of the analog input on the robot is always corresponding to the present finger position.
• Tool output extension The robot tool connecter is extended to the gripper connector

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• Simple installation Runs directly from the robot.
• Integrated control board No need for wiring or external programming.
• Flexible handles many different object. Easily reconfigured.
• Supports two grippers Two grippers can be operated without any extra wiring.
• Adjustable force Is set in the Universal Robots software.
• Wide work range Allows handling of multiple sized objects.
• Quick finger change.

3.3.5 Robotic Arm(3.0)

The Advanced Robotic Manipulator (ARM) 3.0 is a six-axis robotic arm with an open control interface to allow simple implementation into other projects. Each joint is commanded to position via RC PWM signals. Since this is the same signal used to control hobby servos, there is a wide range of devices in the marketplace that can be interfaced to this ARM product. Carbon fiber segments and CNC machined aircraft grade aluminum make the ARM 3.0 a robust unit. With a reach diameter of over 2 meters and ability to lift 4.5kg (10 pounds).

FEATURES

- 2.2 meter Reach Diameter
- Lifts 10 pounds (4.5kg) at full extension
- Total System weight of 9.25 kg (20.4 lb)
- Closed-loop position control at all 6 joints
- Holds position on lower 4 joints with power off
- Absolute, linear feedback from each joint
- Limit switches at ends of travel of linear actuators prevent accidental damage .
- Rugged aluminum enclosure houses control electronics
- DB-25 connector for power and signal input
- On/Off power switch at base
- Carbon Fiber Segments
- CNC Machined Aluminum Construction
- Compatible with conventional radio control units
- Power indicator LED
- 12VDC Power
- Reverse connection protected

**3.4 Hardware Design**

3.4.1 Power Supply Design

Power supply is the important and the most esssential part of our intelligent pick and place robot project. For our project we require +5V regulated power supply with maximum current rating 500mA.

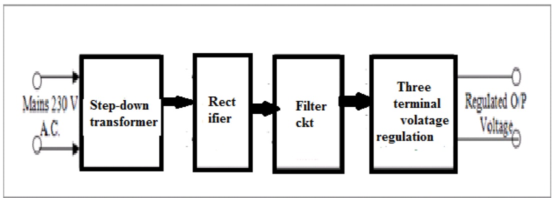


Fig.3.6 Block Diagram of Power Supply

Following figure 3.6 shows basic building blocks of regulated power supply.

• Step Down Transformer

Step down transformer is the first part of regulated power supply. To step down the mains 230V A.C. we require step down transformer. Following are the main characteristic of electronic transformer.

1) Power transformers are usually designed to operate from source of low impedance at a single freq.
2) It is required to construct with sufficient insulation of necessary dielectric strength.
3) Transformer ratings are expressed in volt–amp. The volt-amp of each secondary winding or windings are added for the total secondary VA. To this are added the load losses.
4) Temperature rise of a transformer is decided on two well-known factors i.e. losses on transformer and heat dissipating or cooling facility provided unit.

Selection steps of Step down Transformer:

The following information must be available to the designer before he commences for the selection of transformer.

1) Power Output.
2) Operating Voltage.
3) Frequency Range.
4) Efficiency and Regulation.

• Rectifier Unit

Rectifier unit is a circuit which converts A.C. into pulsating D.C. Generally semi-conducting diode is used as rectifying element due to its property of conducting current in one direction only. Generally there are two types of rectifier.

1) Half wave rectifier.
2) Full wave rectifier.

In half wave rectifier only half cycle of mains A.C. is rectified so its efficiency is very poor. So we use full wave bridge type rectifier, in which four diodes are used. In each half cycle, two diodes conduct at a time and we get maximum efficiency at o/p.

• Filter Circuit

Generally a rectifier is required to produce pure D.C. supply for using at various places in the electronic circuit. However, the o/p of rectifier has pulsating character i.e. if such a D.C. is applied to electronic circuit it will produce a hum i.e. it will contain A.C. and D.C. components. The A.C. components are undesirable and must be kept away from the load. To do so a filter circuit is used which removes (or filters out) the A.C. components reaching the load. Obviously a filter circuit is installed between rectifier and voltage regulator. In our project we use capacitor filter because of its low cost, small size and little weight and good characteristic. Capacitors are connected in parallel to the rectifier o/p because it passes A.C. but does not pass D.C. at all.

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• Three Terminal Voltage Regulator

A voltage regulator is a circuit. That supplies constant voltage regardless of change in load current. IC voltage regulators are versatile and relatively cheaper. The 7800 series consists of three terminal positive voltage regulators. These ICs are designed as fixed voltage regulator and with adequate heat sink, can deliver o/p current in excess of 1A. These devices do not require external component. This IC also has internal thermal overload protection and internal short circuit and current limiting protection. For our project we use 7805 voltage regulator IC as shown in fig.3.7.

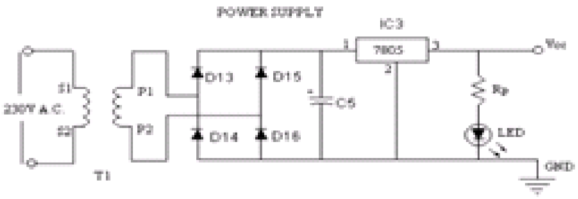


Fig.3.7 Circuit Diagram of Power Supply

Specifications:

- Available o/p D.C. Voltage = + 5V.
- Line Regulation = 0.03
- Load Regulation = 0.5
- Vin maximum = 35 V
- Ripple Rejection = 66-80 (db)

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