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Pick and Place Robotic Grasper using Wireless Communication

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ABSTRACT*:* The robot Hand is a very complicated system composed of a large number of joints. Also, there are limitations of size and weight in the development of the robot .Because of these reasons, to manufacture a useful robot hand is a difficult work. There is a need to define several requirements of a robot hand in the sense of structure and function .Although it is difficult to satisfy all of the requirements, there are two main requirements such as performance and simplicity. Performance is the ability to perform fine manipulation in stable and robust ways. Simplicity relates to mechanical and control, computational simplicity, which directly relates to the cost of products .In this paper a flexible grasper, is used for Robot grasping and pick-and-place task. The main characteristic of this robot is using a special flexible grasper to pick and place operations that reduces the use of complex mechanisms and it reduces the flexibility of the robot and reduce the constraints of the shape of the objects that can be picked by the robot arm. By using a flexible grasper the friction between the object and the robot arm is being increased. By using this mechanism the success rate of pick and place robots is increased. The Robot can be operated by using wireless communication.

KEYWORDS: ARM7, ROBOTIC arm, Zigbee communication module, pressure sensor.

I.INTRODUCTION

Pick and Place robots are widely used in material handling applications in manufacturing applications. Typically pick and place robots need a repetitive motion. The evolution and improvement in the field of robotics and artificial intelligence made this scientific world automated. The robotics reduces the human efforts in the risky operations and for lifting heavy weights [1]. For example in manufacturing process, to pick the items from the conveyer belt and place them for packaging.

A robot is a reprogrammable, multifunctional manipulator designed to move the parts, items, and many special things based on a programmatically motion to perform different tasks. In industrial applications, there are some conditions where human can't be involve such as hazardous environmental conditions, in a repetitive task to be done many times and where accuracy should be maintained every time in a single task. While implementing the robotic systems, the cost also will be a important concern based on the requirement.

In the proposed system of robotic vehicle with pick and place robotic arms, the cost of the system will vary according to the size of the vehicle, arms and it's capability where we consider those arms based on the weights of the objects to be carried out with robotic vehicle. The manufacturing industries needs to manage heavy weights because of their products and materials are huge and robust; there we need the arms nearly in a size of easy lifters. In our system, we are implementing a robotic manipulator which can hold small items with its arms and place them according to the given control command by the user. As robots evolve, they will become more versatile, emulating the human capacity and ability [2] to switch job tasks easily.

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A. Existing System:

In the existing system complex mechanisms are used for pick and place operations. The existing system has a very low success rate [3]. And the objects that can be grasped by the robot are of definite shape. Hence there are several constraints in the existing system of pick and place robots.

B. Proposed System:

In the proposed system instead of metal fingers flexible rubber graspers are used for pick-and-place operations. This system consists of two parts that are helpful for grasping operations. The first part consists of a active grasper that consists of a flexible rubber grip that is controlled by a DC motor that is used to grasp the objects [4]. The second part consists of a passive grasp that consists of a sponge that provides friction for the grasping operation. And it consists of two pressure sensors that are used to control the DC motor rotation and to provide the required grasping force. The robot is controlled via ZigBee through pc.

II LITERATURE REVIEW

"Grasping" indicates an action of a hand on an object consisting in preventing its motions relative to the hand, possibly in the face of disturbance forces acting on the object itself [5]. Different types of graspers have been proposed to improve manipulability of the robotic hands for grasping tasks. These are controlled by using wired or wireless systems. In addition to the big efforts made in grasping technology to design the next generation of dexterous robot hands. NASA's space humanoid is an important accomplishment in humanoid systems, but it is even more significant considering NASA's need for a system that can operate in the extreme environments of space [6]. In this paper we have used the pressure sensor to improve the gripping process.

II WORKING MECHANISM

Hardware Description:

The pick & place system architecture consists of two main sections. They are,

- Robotic section
- Control section.

Robot Section Operation:

This robot section consists of moving arm with flexible grasper, ZigBee transceiver; pressure sensor and LCD interface as shown in **FIG.1.** The robot will be operated using commands from pc connected trough ZigBee. The grasper holds an object on receiving command 'Close' and releases the object on receiving the command 'open'. Robot can be moved in different directions on sending commands like 'right','left',forward'and 'reverse'. The pressure sensor gives the pressure value that is getting applied by the grasper at each and every instant of time. These values can be monitored by the operator at the pc.

Control Section Operation:

In control section contains ZigBee transceiver and personal computer as shown in **FIG.2.** Pc sends user commends to robotic section through ZigBee protocol using virtual terminal.

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Block Diagram:

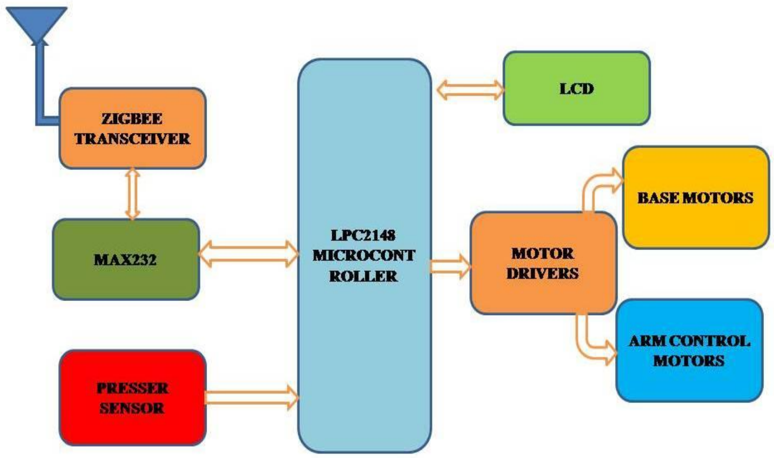

Fig. 1 Robot Section.

The major components in robot section and control section is in robot section we have micro controller and the components like ZigBee transceiver, maxx 232, pressure sensor, LCD and motor driver .In the control section we have only ZigBee & max 232

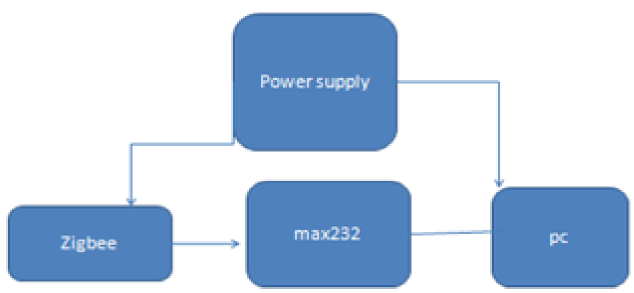

Fig.2 Control Section

MICROCONTROLLER: The NXP (founded by Philips) lpc2148 is an arm7tdmi-s based high-performance [7] 32-bit RISC microcontroller with thumb extensions 512kb on-chip flash ROM with in-system programming (ISP) and in-application programming (IAP), 32kb ram, vectored interrupt controller, two 10bit ADCs with 14 channels, USB 2.0 full speed device controller, two UARTS, two I2C serial interfaces, two SPI serial interfaces two 32-bit timers, watchdog timer, PWM unit, real time clock with optional battery backup, brown out detect circuit general purpose i/o pins.

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MOTOR DRIVER (L293D): Since the output current through micro controller is very low when compared to the requirement current for the motors. The require power is 1 Amp and output current of micro controller is in milliamps. Therefore micro controller can't drive motors directly. Here we need a driver which is used between the motor and controller. The motor driver is called as L293D. It has four channels. Every motor requires two channels to control in both directions. Therefore we need one L293D for controlling of wheel motors and other one is for the controlling the motors of robot arm. It can switch the output voltage up to 36v from 4.5v.

GEAR MOTORS: The normal DC motors don't have gears it increases insignificant increase of Rotations per Minute but at the same time it reduces in torque of the motor. So for the requirement of high torque motors we need to go for the gear motors. In gears motors it reduces the significant amount of RPM and result it increase of torque. As lower the RPM higher the torque. We need high torque motors to move the robot and pick heavy weights.

PICK AND PLACE: The Pick and Place kit consists of the robotic arms to hold an object and also consists of DC motors for arms movement. The kit will have two motors. One is for controlling the arm movement up and down. Another motor is for tighten and loosen the picked object. Again these two motors have to drive their current input from the L293D. The pick and place kit will have a jaw teeth modeled arms to hold the object strongly. While moving the robot, we can simultaneously perform the pick and place functionality if needed.

Fig. 3 Pick and Place Kit

ZIG BEE MODULE: ZigBee is a IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios.

The technology defined by the ZigBee [8] specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer.

Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics .[9] ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking [6] (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250 Kbits/sec, best suited for intermittent data transmissions from a sensor or input device.

ZigBee was conceived in 1998, standardized in 2003, and revised in 2006. The name refers to the waggle dance of honey bees after their return to the beehive. ZigBee is a specification for suit of high level communication protocols using small low power digital communication module require as the Radios based on IEEE802 standard for personal are networks. ZigBee devices mainly used in mesh network form to transmit data over longer distances,

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passing distance through intermediate devices to reach more distance ones ZigBee is used in the applications that require low data rate long battery life, and secure networking. ZigBee has defined rate of 250 Kbits/sec, suited for periodic data or single signal transmission from a sensor to the input device. Applications include traffic management system, and other consumer and industrial equipment that require short range wireless transfer data at relatively low rates.

PRESSURE SENSOR*:* A pressure sensor measures pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical .The following **Fig 4** shows the pressure sensor image

Fig .4(a) Pressure Sensor

The **fig 4(a)** shows the pressure sensor which is used in the gripper part and it is shown in **fig 4(b)** pressure sensor is used to see the pressure values applied on the object by the instructor who give commands to the robot to pick the object and hold it and release the object.

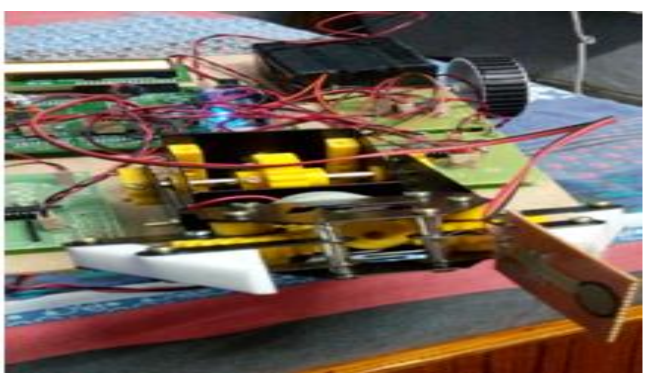

Fig .4 (b) Pressure sensors at AGP

III. GRIPPER MECHANISM

AGP: The AGP (active gripper) that actively makes contact with the work piece, which is a common rubber timing belt made of poly chloroprene rubber and fiber glass. It is being squeezed by a dc geared motor through two identical spur gears. This timing belt features excellent flexibility, stable transmission, high durability, and high strength. So we can make it is an excellent material with which to meet the flexibility requirement and demonstrates a high level of energy transmission efficiency to firmly grasp various objects in real-world environments. The

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intrinsic merit of a flexible AGP over conventional finger based robotic hands is that sensing joint torques and positions of the fingers and finding appropriate forces and wrenches to control each joint become unnecessary. In addition, this part adapts itself to the shape of the object, thus enabling a successful grip of an unknown object of arbitrary shape.

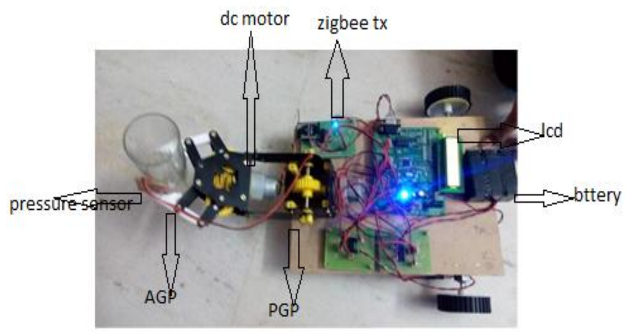

Fig.5 Hardware Components of Robot

The **Fig5** shows all the hardware components of the pick and place robot Four major components of the minimal grasper: AGP, PGP, driving system, and controller.

PGP: The PGP (passive gripper) in which it like as the palm of a human hand and consists of an aluminum plate covered with widely used foam rubber, also having with two FSRs as force sensors (FSR406, Digital Key Corporation), . The PGP consists of three major functions. First, the PGP works as a base plate which generates a retention force the force should being the opposite direction of squeezing. In particular, by the virtue of the sponge characteristic of foam rubber, a stable grip can be implemented. Second, large fluctuations of the AGP, which could make the insertion of the loop into an object to fail, can be prevented by the PGP. Finally, by the aid of the FSR [10], a force feedback control can be implemented which enables the grasper to hold an object stably. Driving System: A dc servomotor, a pair of spur gears, a flange, and a main frame contains in a driving system. There is a rotational motion into linear motion is performed by operating the motor the spur gear performs it. Similar designs have been widely used in rack and pin ion gears and industrial linear actuators. Here, two cylindrical supporters guide the belt to exit the casing without unnecessary contact. Controller: A dc geared motor was controlled by a simple controller and measures the amount of rotation of the motor is designed. The grasps of an object and release the object on a target location is correctly controlled by dc motor. To control the dc motor, a dual full-bridge dc motor driver circuit called L298N was used. In an effort to reduce the number of expensive sensors, only encoder output is measured. In particular, to prevent signal and power noises these three circuits were isolated that could induce control failure.

V. EXPERIMENTAL RESULTS

The performance of the proposed grasper was validated in two stages: manual experiment and semiautomatic experiment. By “manual,” here mean that the objects were manually placed on the grasping part prior to enveloping. The semiautomatic experiment is designed to demonstrate that the grasper can be used in real-life applications. Here, the term “semi automatic” accounts for the fact that all the procedures were automatically conducted except the calculation of the object location as shown in **Fig .5**.Insertion of grasping part downward to the object, enveloping, lifting and releasing the object.

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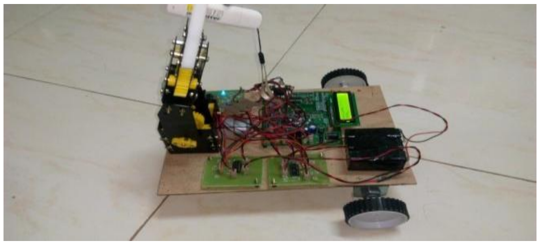

Fig. 6: Motor current input during the developing phase

A. Manual Stand-Alone Experiment:

In this experiment variable shaped objects are placed in grasping part manually for the grasping operation. The dimensions of the object like height and width are not considered .Here, there is no need for locating the object. There is 100% success rate of holding these objects .The result for percentage of grasping for different objects with different materials are shown in **table I.** But we have one drawback in this method that is the robot has no sense of holding the objects automatically with out human attention. This draw back can be overcome by the following Semiautomatic Experiment.

For those experiments, three commonly used objects were selected with different shapes, sizes, and weights, as shown in the below **table I.**

Table I: Object holding results

NO	OBJECT	TRAILS	SUCCESES PERCENTAGE
1	GLASS	5	100%
2	PLASTIC BOX	4	100%
3	PAPER ROOL	5	100%

B. Semiautomatic Experiment:

In semiautomatic experiment the mobile robot is controlled by the operator giving commands to the robot from the hyper link window at pc . The control operations of robot like moving forward, reverse, right and left as well as the grasper control operations like open, close, up and down can also be done by using the pc. The data from the pressure sensors is displayed on the PC by using the Visual Basic. These pressure values indicate the operator about the griping level of the object.

We have operated the machine with objects of different shapes and materials to validate the success rate of gripping like plastic and Glass materials as shown in **Fig.7** and **Fig. 8.**

Fig.7. Gripper Lifting the Plastic Box

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Vol. 3, Issue 11, November 2015

In the **Fig. 7** we can see the robot lifting the plastic box .while lifting it will show the pressure values on the LCD screen at the operator as shown in **Fig. 9**

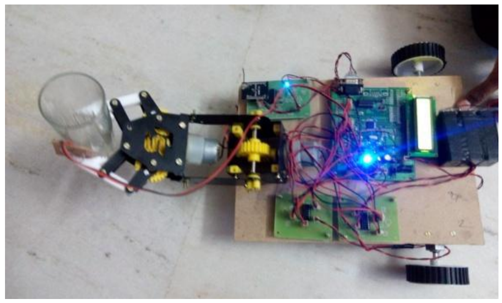

Fig.8 .The Gripper Holding the Glass Object

The machine also got verified for lifting of glass object as shown in **Fig.8**.the pressure values got checked and the success rate of operation is satisfied.

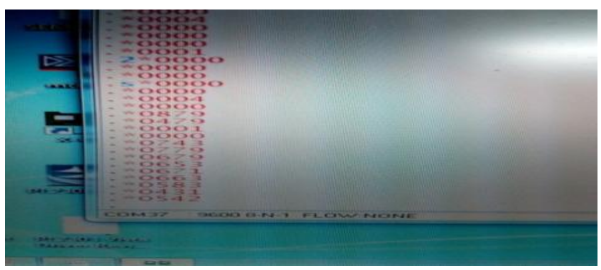

Fig. 9 Pressure values displayed on PC

At the stage of gripping an object the pressure values are displayed on PC at the operator to check the proper gripping of object as shown in **Fig. 7**
In this experiment the pressure values of the object are calculated and they are shown in the **Table II.**

Table II: Result for Semiautomatic Experiment

NO	OBJECT	TRAILS	SUCCESES PERCENTAGE	PRESURE VALUE
1	GLASS	5	100%	463
2	PLASTIC BOX	4	100%	679
3	PAPER ROOL	5	100%	430

.

In **Table II** we can see the results for semiautomatic experiment here we have used three objects and there pressure values are noted we have only one failure case that is when the object is induced when the contact surfaces of the AGP. This will be overcome in the further techniques.

V. CONCLUSION

By using this minimal grasper we can prevent current robotic hands from being commercialized and have considered the various approaches taken by many researches to overcome these difficulties. The grasper gives

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success rates of 93.2% by performed in various real time objects with two features self -adaptively and flexibility. In industrial fields every mechanical part in the proposed grasper is used. This is an advantage over other robotic hand with respect to mass production, with considerable reduction in manufacturing cost. In this it has many merits about its size, light weight and also simple hardware implementation and control algorithms at very less cost compared to the anthropomorphic robotic hands.

Future Scope: Further improvements will be done for the following two issues in future. First one is enhanced planning that minimize the change of the object orientation. Currently the orientation of the object is formed during the enveloping stage. The second one is the improvement of the AGP when object is in contact with the surface which can improve the success rate.

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