Research Article

DEVELOPMENT OF BLUETOOTH BASED PICK AND PLACE ROBOT VEHICLE FOR INDUSTRIAL APPLICATIONS

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ABSTRACT: The increase of human needs is increasing, even it has pushed the robotics sector to evolve even more. Pick and place robots are becoming increasingly important in industries, even they perform specialized tasks instead of humans. They are designed to handle various tasks precisely. It reduces production costs in industries. This work includes a robot arm that can move in all directions. This allows it to work in small spaces and pick up items from various angles. The gripper on the arm handles various directions. A Programmable Logic Controller (PLC) ensures smooth, accurate pick and place robotic arm operation. Therefore, by using Bluetooth robot will move in all directions. Hence, this development of bluetooth based pick and place robot vehicle for industrial applications will reduce cost, work accurately and time saving.

KEYWORDS: Programmable Logic Controller (PLC), Robots, Industries, Bluetooth, Pick and Place Robots

I. INTRODUCTION

The technology in recent decades developed at a rapid pace, this results to have innovative solutions that facilitate and make human life safer [1] In particular, the robotics industry has a long-term goal of minimizing the manual work carried out every day by people and improving any task that requires human skills such as accuracy, speed and power. Primarily the robotics application fields which caused the biggest development are in the department of robotic arms and small robotic vehicles, which are automated, moving autonomously and transferring information via the Internet or a local network to the central control station. Only in recent years, the field of robotic automatic vehicles has seen the rapid development in the areas of the remote control and monitoring space [2] The robotic vehicle sector includes user mechatronics, artificial intelligence and multi-agent (multi-agent Systems systems) to help the operation of vehicles. These are the characteristics that make the vehicles are eligible to be designated as intelligent or smart.

A vehicle that uses automation for difficult processes, in particular for navigating, can be described as semi-automatic. While those vehicles based solely on automation systems are referred to as robotic or autonomous. After the invention of the integrated circuit, the complexity of the technology of automation systems has been increased [3] Manufacturers and researchers then added a variety of automated functions mainly in cars and other vehicles. In general, a car is characterized as autonomous when it is capable of recognizing the environment and moving within it, without human intervention [4]

The autonomous vehicles detect their environment by using technologies such as radar, LIDAR (Light Detection And Ranging), GPS, Odometry and Computer Vision. Advanced control systems read and process information from the measurements of the sensors to identify suitable navigation paths, and obstacles and the relevant markings. Autonomous cars have control systems that are able to analyze the sensor data to distinguish between different cars on the road, which is very useful for planning a route to the desired destination. Under the term 'autonomously', the vehicle will also have the possibility of self-government (self-governance) [5]

Many historical research projects related to vehicle autonomy are actually automated (they are made to be automatic) rely heavily on artificial elements of their environment, such as magnetic tapes [6] The autonomous control requires good performance under significant uncertainties of the environment for long periods and the ability to offset the potential damage of the system without external intervention. As can be seen from many projects reported frequently proposed to extend the possibilities of the autonomous car through the implementation of communication networks with both directly adjacent cars (Collision Avoidance) and long (for managing congestion). Adding two more outside influences in the decision-making process, some now consider the behavior or the potential of the car as autonomous [7]

In the past, generally, robotics mainly used for an automated production process in the factory. Presently, robotics finds its application in many fields such as medical science, mining, surveillance, autopilots, etc. Initially, robotics was understood to be a job eaterand was seen as a destructive replacement technology. With time, robotics has emergedas a safe and viable technology in complex and unstructured conditions such as au-tomating the number of human activities, automated driving, caring for a sick person, military sector and in the car industry, etc. In robotics design, there is mainly two-points in which the designers are focusing the first one is to build a model that canact autonomously in complex and unstructured environmental conditions. Second, thedeveloped model has the capability of making moral decisions [8]

At present, robotics has emerged as a potential technology that can ease human life and enable mankind to tackle several social and ethical issues. Learning, not clearly understanding about the problems, Creativity for solving the problems, Reasoning and Deduction, Classification, Ability to build analogies and many more are the common features of intelligent system. In fact, multipurpose systems are the need of the hour and are well accepted in tech-savvy populations [9]

In the last 25 years robotic vehicles, usually named intelligent vehicles, became important part of service robotics. It is estimated that over 1 billion passenger vehicles travel the streets and roads of the world today. With such traffic, it is clear that there are many situations where the driver has to react quickly [10] In many cases, the driver is not able to react, that is why applications of automated systems are involved in the vehicles. These automated systems solve various tasks, with which the driver meets during normal operation of the vehicle. An intelligent vehicle is defined as a vehicle equipped with perception, reasoning, and actuating devices that enable the automation of driving tasks such as safe lane following, obstacle avoidance, overtaking slower traffic, following the vehicle ahead, anticipating and avoiding dangerous situations, and determining the route. The general motivation for the development of intelligent vehicles is safer, more convenient and efficient road traffic. Current research on intelligent vehicles is focused on realistic conditions. Therefore, mainly because of legal issues, it is not the ultimate aim of research teams to construct a fully autonomous vehicle. Automotive industry itself sees its task in research of supervisor and assistance systems. In addition, the transport authorities in the world do not attempt to address the autonomous transport systems, but in particular to reduce fuel consumption of vehicles, expansion of road network and increase the life of roads and vehicles.

II. LITERATURE SURVEY

M. . -J. E. Salami, N. Mir-Nassiri and S. N. Sidek , et.al [11] design and modeling of a robotic arm gripper that has elements of intelligent decision making while grasping object has been previously discussed. This new system is different in that it uses an appropriate controlling scheme so that the correct force is applied to pick an object without dropping or crushing it. This is achieved by controlling the shear stresses at the interface material between finger-ends and the object using smart sensors and an intelligent controller. A slip sensor that is based on the operation of an optical encoder is used to monitor the slip rate as a result of insufficient force being applied to pick an object.

R. Szabo and A. Gontean, et.al [12] control and detection in space of the SCORBOT-ER III industrial/educational robotic arm. The robotic arm has glued markers on the joints, which are distinguished using image processing techniques. These key points on the robotic arm are joined with lines, which are overlaid on the initial image. These lines fill in as direction for further mathematical calculations, which makes possible the controlling of the robotic arm. The robotic arm's position is recognized with stereo cameras, this way have the possibility to be controlled in the 3D space.

Z. Zhang, X. Wang, S. Wang, D. Meng and B. Liang, et.al [13] distributed Fiber Bragg Grating (FBG) sensor array is designed and the shape reconstruction algorithm based on curvature information and the Frenet frame is simplified. The considered soft robotic arm consists of two extension pneumatic muscles (EPMs) in series. Firstly, the distributed FBG sensor array is built. Secondly, the curvature information of each grating point is collected and a continuous curvature curve is obtained by using the interpolation algorithm. Thirdly, the two-dimensional shape curves are reconstructed for the two EPMs according to the simplified shape reconstruction algorithm. Finally, the shape curves of the two EPMs are integrated into the three-dimensional shape curve of the soft robotic arm.

R. Szabo and A. Gontean, et.al [14] presents a SCORBOT-ER III type robotic arm which can be controlled only with an FPGA board. The robotic arm is an industrial/educational robotic arm which can execute a high number of tasks, but instead of a computer, only an FPGA development board is the control system. The robotic arm can be used also as a Sun tracker robotic arm. If the position of the sun in tracked the solar panel's efficiency can be increased. The robotic arm is controlled using image processing techniques.

S. Bularka, R. Szabo, M. Otesteanu and M. Babaita, et.al [15] presents an application on how to control a robotic arm with the hand movement of the operator. Hand movement controlled robotic arms can move more naturally by following the movement of the operator's hand. The implementation is done in two versions. The first one uses the accelerometer from a smart watch and based on the operator's hand movements the robotic arm is controlled. The second one uses the accelerometer from a smart phone and moves the robotic arm accordingly. With the smart phone the robotic arm can be controlled in two ways by finger gestures on the touch screen or by moving the phone in the air. The smart phone connects to a computer which controls the robotic arm by sending commands on the serial interface.

R. Kannan Megalingam, T. Pathmakumar, T. Venugopal, G. Maruthiyodan and A. Philip, et.al [16] focuses on wireless controlled robotic arm using DTMF (Dual tone multi frequency) technique. The arm is designed to be a part of a coconut tree climbing robot. As the number of human coconut tree climbers is dwindling, there is a dire need for a robotic climber. The robotic arm is capable of a two axis rotational movement. The entire robotic arm can be controlled by using a remote device — mobile phone which hosts the DTMF Technology. The remote device can be used to control the movement of the arm.

C. -W. Chen, R. -M. Hong and H. -Y. Wang, et.al [17] presents a design of controlled robotic arm with myoelectric and body action signals. The implementation uses the sensed signals, via the signal processing of ARDUINO UNO R3 development board and NUC140VE3CN development board (ARM processor), to control the robotic arm wirelessly. The proposed design can be used in the dangerous operation environment. The users can contactlessly control the robotic arm safely. And it can operate specified action repeatedly and accurately for factory manufacture. The rotative angle of robotic arm controlled by Servomotor is decided by pulse width modulation signal obtained from microcontroller via BlueTooth 4.0 wireless technology.

P. S. Lengare and M. E. Rane, et.al [18] interfacing of human hand using robot arm. With this method the robotic hand can be controlled using human hand. Its demonstration is done by using image processing technique to detect different colors at different axis of human hand. This technique is very useful since it takes real time video of hand and tracks it to get interface with robotic arm. A laptop camera will get the video and track the RGB (red, green and blue) colors at different axis of hand denoting X and Y axis. Tracking of such hand will interface the controller with robotic arm.

R. Szabó, A. Gontean and A. Sfiraţ, et.al [19] robotic arm control, with color recognition, implemented on a Raspberry PI, will be presented. The Raspberry PI is a small super computer which is suitable for almost any embedded project. To the Raspberry PI is connected a Logitech C270 web camera or a TP-LINK TL-SC3230 IP camera and a USB to serial dongle which does the communication task. The camera pair films the robotic arm and the USB to serial dongle controls the robotic arm. The color recognition is done with OpenCV installed on the Raspberry PI. The robotic arm has glued colored bottle stoppers on the joints which are recognized with color filtering.

S. Noor et al., [20] propose an “Artificial Human Hand Model” which can precisely follow the real movements of human hand by means of image processing thereby avoiding sensor noise and damage and providing more adjustable response. Webcams are used to capture the hand images followed by Morphological image processing to extract information from human hand movement. The five degrees of freedom implemented in the proposed method are rotation of base, arm like motions, elbow like motions, grip motions, and rotation of grip. The robot hand is controlled successfully using human hand movement, where the system can pick up, manipulate and move objects from one place to other with precision.

P. P. Sarker, F. Abedin and F. N. Shimim, et.al [21] a low-cost gesture-controlled robotic arm system, namely R3Arm (Remote Rescue Robotic arm) is developed for the remote rescue operation. It offers remote manipulation with ease of portability. The robot can be deployed to places where no humans can go and has the ability to become part of massive rescue operations. It also offers live video feed of its operation and can save human life stuck in difficult situations if built with the proper structure which certifies the advantage of its modular body. The robot's arms are equipped with claws and possess three degrees of freedom which helps to grab and move a wide variety of things.

G. Lan, Y. Bu, J. Liang and Q. Hao, et.al [22] presents a novel automatic system that remote operations between the user arm and a multi-rotor UAV robotic arm to achieve synchronizes actions. The system contains three parts: two sets of IMU motion sensors, a six-degrees-of-freedom robotic arm attached to a UAV, and a ground station that displays the real-time videos sent back by the UAV-based camera. The system targets to perform operations in a remote or hazardous environment, such as water sampling, leakage estimation, or radiation measurement. A two-step control scheme is developed to achieve action synchronization for remote operation.

III. FRAMEWORK OF AN DEVELOPMENT OF BLUETOOTH BASED PICK AND PLACE ROBOT VEHICLE FOR INDUSTRIAL APPLICATIONS

In this section, framework of a development of bluetooth based pick and place robot vehicle for industrial applications is observed in Figure.1.

A voltage regulator is connected to programmable logic controller. The servo motors are connected to PLC controller. Then the command given to servo motors for vehicle direction. Bluetooth device is connected to PLC, android application is connected to bluetooth device. Then the command is given to DC motor drive circuit, then finally robot arm will move.

A voltage regulator is a system designed to automatically maintain a constant voltage, and it may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components. It may be used to regulate one or more AC or DC voltages by depending on the design. A servo motor is a rotary actuator that allows for precise control of angular position. It consists of a motor coupled to a sensor for position feedback, and it also requires a servo drive to complete the system. The drive uses the feedback sensor to precisely control the rotary position of the motor.

DC motor drives are defined as amplifiers or power modules that interface between a controller and a DC motor. It converts step and direction input from the controller to currents and voltages compatible with the motor. A motor driver known as a control motor, it is an electronic device or module that controls and manages the operation of an electric motor. It serves as an interface between a microcontroller or other control system and the motor itself. It enables precise control of the motor's speed, direction, and other parameters. Bluetooth module is a basic circuit set of chip which integrated Bluetooth functions and which can be used in wireless network transmission.

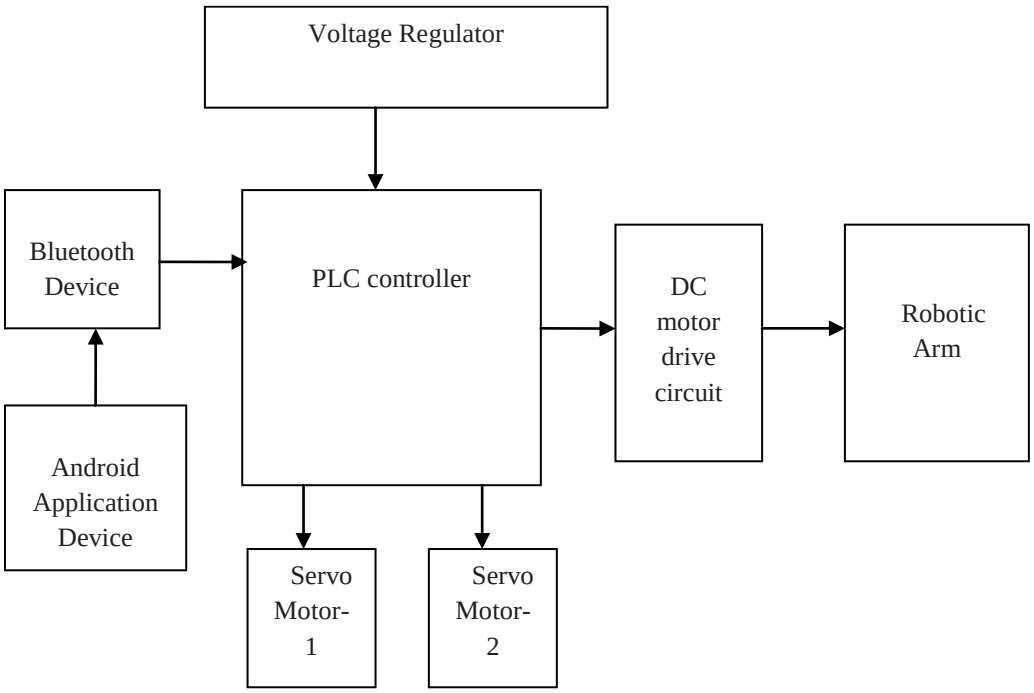

Fig.1: Framework Of An Development Of Bluetooth Based Pick And Place Robot Vehicle For Industrial Applications

connect within a home network, enables centralized control and automation.

Android is a mobile operating system based on a modified version of the Linux kernel and other open-source software. It is designed primarily for touchscreen mobile devices such as smartphones and tablets. Pick & place robot arms are used in assembly lines or bin picking lines to move material easily from one place to another. These Robotic arms will help to keep workers safe by operating in environments that are hazardous and executing tasks that present high risk of injury to humans for an improved efficiency and productivity.

A programmable logic controller or programmable controller is an industrial computer that has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, machines, robotic devices, or any activity that requires high reliability, ease of programming, and process fault diagnosis.

IV. RESULT ANALYSIS

In this section, result analysis of a development of bluetooth based pick and place robot vehicle for industrial applications is observed.

Table.1: Performance Comparison

Parameters	Micro Controller Robot	PLC Robot
Accuracy (%)	89.3	96.8
Time (sec)	96347	81769
Cost (%)	86.4	78.1

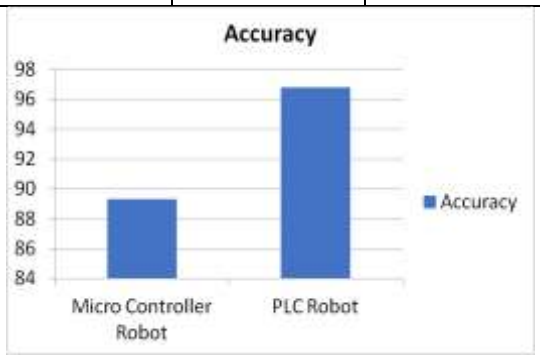

Fig.2: Accuracy Comparison Graph

In Fig.2, accuracy comparison graph is observed between Micro Controller Robot and PLC Robot. The PLC Robot shows high accuracy for development of bluetooth based pick and place robot vehicle for industrial applications.

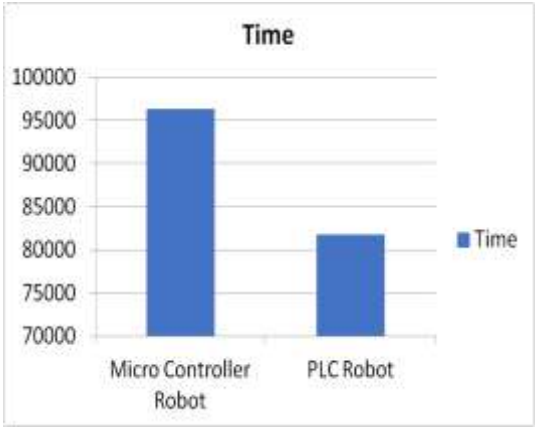

Fig.3: Time Comparison Graph

Time comparison graph is observed between Micro Controller Robot and PLC Robot in Fig.3. The PLC Robot shows time saving for development of bluetooth based pick and place robot vehicle for industrial applications.

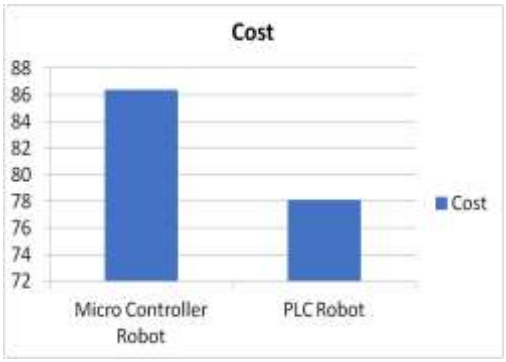

Fig.4: Cost Comparison Graph

In Fig.4, cost comparison graph is observed between Micro Controller Robot and PLC Robot. The PLC Robot shows low cost for development of bluetooth based pick and place robot vehicle for industrial applications.

V. CONCLUSION

Hence, development of bluetooth based pick and place robot vehicle for industrial applications is concluded in this section. Nowadays various advanced robots are used in industries but still controlling is done manually or using processors likewise Arduino, microcontroller. But these microprocessors have several disadvantages, it can be overcome by PLC. Here Programmable logic and controller is used for controlling and operating robotic arm. All the various issues of this process have been analyzed properly and have been taken into consideration while programming and designing the pick and place robotic arm. Hence, by using robotic arm, the things will pick up and place, it is very useful in industries. Hence, this system achieves better result interms of accuracy, time saving and cost reduction.

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