A Review: Industrial application of smarthost microcontroller based robots

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Abstract: *Robotics is a combination of science, engineering and technology that produces machines, called robots, that can replace human actions. Robots imitate the action of human beings; it can perform the task not only what a human can do but also what they not able to do. This paper provides an overview of a robotic arms that can be controlled using a smart host microcontroller and can be powered by either solar energy or by direct power supply. The paper includes a thorough review of the referenced papers, which focuses on the development of the robotic arm with the use of smart host microcontroller and a camera function for real time image processing. There are different research papers are followed and real time image processing based Robotic arm showed the better performance and applications among other Arduino or Raspberry pi based robotic arms. Different robots/ robotic arms are capable of surveillance and also with an alternate application in detecting and following a pre specified object. There are various fields where these robotic arms play a vital role such as, in farming a robotic arm can be used to pluck fruits/vegetables from trees and plants or to implant seeds into soil without the need of human touch, in military base to remove the land mines that can be harmful for soldiers, in the medical industries (complicated surgery or pharmaceutical field), in the field of science, where a nuclear waste can be disposed by the help of a robotic arm so that it may cause no harm to any human being.*

Keywords: Robotic Arm, Smart Host Microcontroller, Power Supply, Real Time Image Processing, MATLAB.

1. INTRODUCTION:

A robot is an electro-mechanical machine that perform tasks based on the command or instruction given as the input [27]. It can be fixed or movable as per the requirements. Such as in industry purposes the robots used have a fixed base (e.g., in automobile industries the robots have a fixed function of manipulating/adjusting the parts of vehicle). The robots whose base can move have different requirements or are used to perform different tasks (e.g., mars rover have a movable base that can move from one place to another, that help scientists to collect data regarding their research onmars).

In this project a movable robotic arm can be programmed to perform pick and place operations that can help us humans perform tasks that require extra strength or that are not easy to perform [29]. For automatic purposes, the robot is more advantageous than a human because it works simultaneously / continuously without resting. Robotic arms can be useful in many areas, such as in agriculture, robotic arms can be used to unload fruits / vegetables from trees and plants, or to plant seeds in the ground without the need for human touch, or in military bases [34]. Mines that can be harmful to soldiers, or in the field of science where nuclear waste can be disposed of, can be done with the help of a robotic arm so that it does not harm any human being.

The atmega328p microcontroller can be used to control I / O signals to operate robotic components. The atmega328p microcontroller is an 8-bit microcontroller based on AVR RISC (Reduced Instruction Set Computer) technology [2]. It is a high performance, low power controller from microchip. Compared to the 8051 microcontroller the atmega328p controller is more efficient and more versatile as it has more storage space and software already built to encrypt it. Atmega328p is already used in Arduino which makes it easy to install as

Arduino has software called Arduino IDE 1.8. While Arduino can also be configured with any compiler such as C / C ++ compilers, which makes it easy to use or code. And being part of Arduino, it provides a USB port to connect to a PC and where we can provide robotic navigation instructions using the MATLAB GUI.
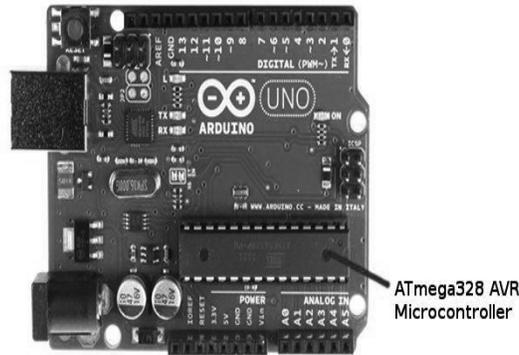

Fig. 1.1: This picture represents an Atmega328 based Arduino.

From MATLAB GUI interface we can make some sort of buttons or menus at which a click or press can provide movement to the robot. Such as by clicking forward, the robot will start moving forward and by clicking backward it will begin moving backword.

For the movement of robot, motors will be connected with relays. These relays will work as switches that can be activated when the input from the MATLAB will be 1 and the motor will begin to rotate. Considering the rotation of motor, if it will be clockwise then the robot will move forward and if it will be anti-clockwise then it will move backward [2]. Same as for the movement of arm, a motor will be connected and the direction of rotation of the motor will tell the function of arm (e.g., if clockwise then arm will move upward and if anti-clockwise then the arm will move downward).

The gripper can be used for selected operations operation in the robot. When the input is 1 the gripper will be close and for 0 it will be open. This will act as a hand that can hold objects on commands. Now, the robot will be supplied with electricity by solar energy radiation or direct power supply. A PV cell module that acts as a battery is to be connected to a robot and a solar panel. The condition of the battery will be measured by a ZigBee connected to the PC; Considering the condition of the battery, it will start using the solar panel for battery charging [21]. Between the battery and the solar panel, a diode will be connected to prevent the reverse flow from the battery to the solar panel.
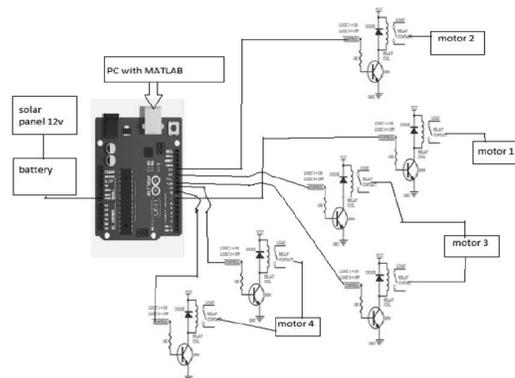
Fig. 1.2: Connection of the Arduino with Servo Motors.

Another aim of the robot is to pick a pre-specified object and place it in a separate division based on the colour of the object. This is used to identify objects on the basisof their colours and command the robot accordingly. The image processing in the robot will be done through a software called Raspberry Pi [40].

A Raspberry pi is used as a processing hardware which will help in the detection of the colours and give the characterized aspects of four different methods that are shape,position, orientation and identification of the objects. A raspberry pi in this robotic arm will have700mhz CPU and 256mb ram and it will be used alongside with MATLAB software [9]. A total programming model is developed through MATLAB software and usedin the robotic arm processed by raspberry pi.

2. REVIEW PREFACES:

Basic element of this effective robotic system not only consist of the robot itself, but also the image processing, GUI (Graphical User Interface) controller, gripping tool, pv cell, and most importantly a person to control the robot [3]. Such a composite robotic operation can only be successful when all the parts of the robot will be successfully in conjunction.

From GUI, a signal will be sent to Arduino, with the help of serial communication between the computer and Arduino, using a computer system. The Arduino will then pass a signal to the motor or gripper which will help in the motion of these components depending on the type of manual signal generated from the GUI. Similarly, the state of the robot's battery will be controlled from the PC screen. For the autonomous function of the robot, the robot will be able to program. This autonomous task will help to complete repetitive tasks or tasks that require constant attention of the person. As the farmer is important in farming so that he can take fully ripe fruits / vegetables, now using a robot it will be programmed in such a way that it will pull or select the fruit based on the colour and then place it in a bucket that will be for that fruit.

3. SUMMARY AND DISCUSSION:

An extensive research and development has been undertaken in robotics, therefore it was felt that a review bring up-to-date was necessary. The aim of the review is to offer the inclusive list of foremost research papers developed and published in the last few years.

Many research papers and a range of literatures, databases and search engines such as IEEE explore. Research Gates has been reviewed. The paper has focused on systems for robotic arm, image processing, visualization, pick and place of robot, solar power battery charging, etc.

For the better understanding of system/subject, this paper contains a detailed description of the components and is provided by some useful publications of the authors that has worked in the same field previously.

Table 1 will provide the complete summary of the research papers read and used in the making of this review paper.

This table also provides the summary data regarding the title of the research paper, the year at which it was published, author names, publication of the paper on any search engines, remarks given on the research papers based on the study and complete analysing of these research papers, applications of the paper and microcontroller used in making of each paper.

The table is arranged in such a way that the reader is able to identify the returnable documents from the most recent year to the oldest.

Table 1: A Synthesizing summary of the papers reviewed under the making of this project. In addition to the title, year, author, remarks, publications and applications, each paper has been categorized in relation to the microcontroller used.

S.No.	Title	Year	Author	Publication	Microcontroller used	Remarks	Applications
1.	Implementation of Gesture Control Robotic Arm for Automation of Industrial Application [27]	2020	ShriyaA.Hande, and Nitin R.Chopde	International Journal of Scientific Research in Science and Technology	Atmega328p	In this paper a gesture recognition based 6Degree Of Freedom robotic arm controller using accelerometer is proposed to increase the stability and to sense the rotational gesture of human arm.	Entertainment applications Automation systems An easier life for the disabled
2.	Design and Implementation of an APSoC-based robotic system with motion tracking teleoperation [28]	2019	C.Paparizos, N.Tsafas and M.Bribas	International Conference on Modern Circuits and Systems Technologies	Arm Cortex A	the design and employment of a robotic chassis bearing arm manipulator is offered by authors in this paper.	Robotic Applications
3.	Solar Powered Robotic Vehicle for Optimal Battery Charging using PIC Microcontroller [38]	2019	Ganesh Prabhu S, Karthik S, S Satheesh Kumar, Thirrunavukkarasu P P and LogeshKumar S	International Research Journal od Multidisciplinary Technovation	PIC16F876A Microcontroller	The main focus of this paper is to design and construction of an optimized charging system for Li-Po Batteries by Means of tracked solar panels.	Research Applications

No.	Title	Year	Authors	Publication	Hardware	Description	Keywords
4.	Implementation of ZigBee/802.15.4 in Smart Grid Communication and Analysis of Power	2014	Mulla, A. Y., Baviskar, J. J., Kazi, F. S., & Wagh, S. R.	Annual IEEE India Conference (INDICON)	N/A	In this paper the importance of ZigBee is shown which proves that it is a low-cost, low-power consumption, wireless mesh networking standard.	Short Range Wireless Networking
5.	Robotic arm with real-time image processing using raspberry pi, Both automated and manually [40]	2018	Dr.A.Brintha Therese and Prashant Gupta	International of Advanced Research (ijar)	Raspberry Pi	This paper is about a robotic arm that is functioned using real time image processing.	Efficient Image Capture
6.	Robotic Arm Control with Hand Movement Gestures [19]	2018	Szilard Bularka, Roland Szabo, Marius Otesteanu, and MirceaBabaita	International Conference on Telecommunications and Signal Processing	Atmega328 with SSC-32U	This paper is about an application of robot in which control of a robotic arm with the hand power of the operator is explained.	N/A
7.	An Automatic Battery Charging in Solar Robotic Vehicle [41]	2018	Mallikarjuna, P. and Gowd, B.U.M.	ISS International Journal of Research in Computer Science	PIC 16F877A	This paper focusses on the design and structure of charging systems of LiPo batteries with the help of tracks solar panels.	sensed solar panels to get maximum powerin PV panels

No.	Title	Year	Author	Journal/Conference	Platform	Description	Application
8.	The role of zigbee technology in future communication system [42]	2009	Dr.S.S.RiazAhamed	Journal of Theoretical & Applied Information Technology	N/A	Standard and used in Wireless Personal Area Networks (WPANs) for high level communication. This technology is created by the ZigBee Alliance. Wireless Sensor Networks (WSN)	low-cost, low-power wireless IoT networks
9.	Robotic Arm Design, Development and Control for Agriculture Applications [23]	2017	Rajesh Kannan Megalingam, VamsyGedela, Shiva Pandiraadhyar and Muhammad...	International Conference on Advanced Computing and Communication Systems (ICACCS)	Arduino UNO	This paper is about the design, development and control of a robotic arm for the farming applications.	N/A
10.	SCORBOT-ER III Robotic Arm Control with FPGA using Image Processing with the possibility to use as them as Sun Trackers [43]	2017	Roland Szabo and AurelGontean	International Conference on Telecommunication and Signal Processing	Arm Cortex	This paper offerings a SCORBOT-ER III type robotic arm that can be controlled only with an FPGA board.	Image Processing Applications
11.	Static Gesture Recognition based Precise Positioning of 5-DOF Robotic Arm using FPGA [44]	2017	M.Deepan Raj, I.Gogul, M.Thangaraja, V.Sathiesh Kumar	Trends in Industrial Measurement and Automation (TIMA)	odroid xu4	In this examination work, static motion based acknowledgment framework and exact situating of an automated arm utilizing field programmable entryway clusters is proposed.	Gesture Recognition

S.No.	Title	Year	Author	Conference/Journal	Processor	Description	Applications
12.	Teaching and Learning Robotic Arm Model [45]	2017	Kadirimangalam Jahnavi, Sivraj P.	International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT)	Atmega2560	This is a review paper on a mechanical arm and their turn of events. It gives a specialized prologue to a portion of the new examination work in this field. This is a functioning field of examination wherein there are	Robotic Arm Applications
13.	Real time intelligent image processing system with high speed secured Internet of Things: Image processor with IOT [46]	2016	M Dinesh and K Sudhaman	International Conference on Information Communication and Embedded Systems (ICICES)	ARM926EJ-S	In this Paper additional feature to the idea of Real Time Image Processing System established on 32-bit Arm processor has been presented which is LI-FI enabled Internet of Things.	Education System Medical Applications Internet Of Things
14.	Industrial Robotic Automation with Raspberry PI using Image Processing [37]	2016	Roland Szabo and AurelGontean	International Conference on Applied Electronics	ARM Cortex-A7and	The point of this paper is to introduce a framework controlled by a raspberry PI and a modern automated arm, which can execute various assignments in a manufacturing plant.	Image Processing Applications
15.	Implementation of Embedded Real-Time Image Processing System based on ARM and DSP [47]	2015	L.Q.Ji and P.Y. Permarupan	Journal of Mechanical Engineering Research and Developments	ARM920T kernel	This paper presents the inserted picture handling framework capacity and general plan technique in light of ARM and DSP, essentially for equipment plan of the framework's DSP and	Applications of Image Processing

No.	Title	Year	Author	Journal / Conference	Processor	Description	Application
16.	Robotic Arm Controlling using Automated Balancing Platform [29]	2015	Alok Deep, Jyoti Singh, Yogendra Narayan, Dr S.Chatterji and Dr Liri Mathew	Communication, Control and Intelligent Systems (CCIS)	Atmega328	This paper addresses an Automated Balancing Platform utilizing Arduino Uno (Atmega328 Microcontroller).	Industrial Applications
17.	Web based Monitoring and Control of Robotic Arm Using Raspberry Pi [31]	2015	PandapotanSiagian and KisnoShinoda	International Conference on Science in Information Technology (ICSITech)	ARM1176 micro-processor	In this paper, the specialists propose an automated arm to be utilized predominantly in industry application like compound enterprises; mechanical contraption architects' research facility and so on	industry application like chemical industries; mechanical industries; mechanical apparatus designers' laboratory etc.
18.	Design and Implementation of networked real-time Control system with image processing capability [32]	2014	Zhao Jun and Guo-Ping Liu	UKACC International Conference on Control	Arm Cortex M4	This paper depicts the plan and executions of an OMAP3530-based Networked control framework which has continuous handling ability.	Applications of Image Processing
19.	Embedded Image Processing Engine using ARM Cortex-M4 based STM32F407 Microcontroller [30]	2014	DeveshSamaiya	AIP Conference Proceedings	ARM Cortex-M4 based STM32F407 Microcontroller	This work presents a minimal expense, moderate execution and programmable Image handling motor. This Image handling motor can catch continuous pictures, can store the pictures in the long-lasting stockpiling and	Image Processing Applications

No.	Title	Year	Author	Conference / Journal	Microcontroller	Description	Application
20.	Microcontroller Based Robotic Arm: Operational to Gesture and Automated Mode [35]	2014	Mohammad Javed Ansari, Ali Amir and Md. AhsanulHoque	International Conference on Electrical Engineering and Information & Communication Technology	Atmega Microcontroller	This paper is a drive to disparage the automated arm for perilous circumstance individuals who can utilize his hand to move object inside specific reach to do that work.	Gesture Control Robotic Arm
21.	Design and Development of Digital PID Controller for DC Motor Drive System Using Embedded Platform for Mobile Robot [48]	2013	Chandra ShekharGohiya, S.S.Sadistap, S.A. Akbar and B.A.Botre	International Advance Computing Conference (IACC)	ARM9 based S3C2440 processor	This paper draws out a discrete PID control component for agribusiness versatile robot.	Robotic Applications
22.	Development of dual robotic arm system based on binocular vision [33]	2013	Guo-Shing Huang, Xi-Sheng Chen and Chung-Liang Chang	CACS International Automatic Control Conference	Atmel AT89S52	The fundamental reason for this examination paper is to zero in on the down to earth plan and control of the automated arm, which is mounted on the versatile mechanical body	Robotic Arm with Image Processing Applications
23.	Design and Development of Object Recognition and Sorting Robot for Material Handling in Packaging and Logistic Industries [34]	2012	Vindhya Devalla,Dr. Rajesh Kumar Singh,Amit Mondal,VivekKoundal	International Journal of Science and Advanced Technology	ATMEGA 16	This paper presents an application to sort objects in view of its shading utilizing a mechanical arm.	Drawing the schematic on the plane paper

| 24. | Practical applications for robotic arms using image processing System Theory | 2012 | Mihai AncaNicoletaMihalache Dragusu, and ... | International Conference on System Theory, Control and Computing (ICSTCC) | N/A | This paper explains the functional applications for a mechanical arm in light of picture handling. | applications in robotic manipulation, computer vision, and mechatronics |
| 25. | A portable vision-based real-time lane departure warning system: day and night [48] | 2008 | Pei-Yung Hsiao, Chun-Wei Yeh, Shih-Shinh Huang and Li-Chen Fu | IEEE Transactions on Vehicular Technology | Arm Processor | In this paper, the creators proposed an installed Advanced RISC Machines (ARM)- based constant LDWS. | Image Processing Lane System |

4. CONCLUSION:

The design and development of the robot will be carried out and as a result the working model of this robot will be constructed/build. This will help in completion of objectives such as to be used in farming, andhence conclude the successful working of the robot. The working of the microcontroller atmega328, Zigbee, relays and other components will be known. The fully developed model of this robot will be able to pick up some amount of weight.

Serial communication between the microcontroller and the PC will be established which will help Arduino to control the movement of the robot through the use of PC commands. This robotic vehicle can be helpful for military purposes to remove land mines. Therefore, the purpose of this robot will be very effective for the future instead of human for war, robots can be used for military purpose and energy can be obtained from solar energy which is a major renewable tool. Success in the implementation of a solar powered robotic vehicle with a robotic arm and real time image processing will be very effective in the future of the robotic world.

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