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MONITORING AND CONTROLLING ROBOT USING IOT

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ABSTRACT

The integration of the Internet of Things (IoT) with robotics has revolutionized the field of automation. The synergy between IoT and robotics opens up new horizons for real-time monitoring, remote control, and automation of robotic systems. IoT-enabled robotic systems harness a network of sensors, connectivity, and cloud computing to collect data, transmit information, and execute commands seamlessly. The ability to monitor robotic operations in real-time and exert control remotely has far-reaching implications across various industries, including manufacturing, healthcare, agriculture, and logistics. The key components of IoT in robotics, emphasizing the role of sensors, data transmission and user interfaces. It highlights the benefits of IoT, including improved efficiency, reduced downtime, and the capacity for remote operation, which translates into increased productivity and cost savings for businesses.

Keywords: IoRT, Raspberry Pi Robotics, Remote Control, IoT Integration, UI (User Interface), Cloud Computing.

I. INTRODUCTION

The emergence of technology has managed to witness the evolvement of a new era known as the Internet of Things (IoT). The Internet of things (IoT) further describes the internetworking of physical devices, vehicles, buildings, and other items which include electronics, software, sensors, actuators, and network connectivity that allow these objects to collect and exchange data. In addition, it also allows objects to be sensed or remotely controlled across an existing network infrastructure, which will result in increased performance, accuracy, and economic benefit. At present, robot is employed by almost all of the industries because its added benefits may make up for things human cannot do. It is reliable and accurate in execution, safe to work around extending well into dangerous areas that man can no longer enter due to extreme causes such as high temperature or low pressure. Hence, it is safe to say that robot is used as a human replacement.

A robot is thus defined as a machine which does work by direction of the program created by the user. Even more importantly, it allows several tasks to be done at the same time. Robotic arms are the most common type of robot used for industrial purposes. A generally speaking, the robotic arm is a mechanical arm that can be programmed and its functions are similar to those of a human arm. The pick and carry robotic arm moves around a number of places, for example picking up various objects. The current revolution of IoT coupled with the growing usage of robots in daily activities have turned the Internet of Robotics Things (IoRT) applications into a tangible reality in the nearest future. The advantage of IoRT is that it allows robotic systems to connect, share, and pass the distributed computation resources, business activities, context information, and environmental data with each other. Interesting however is that users can delegate the task to it remotely, through networks, provided that the robot has a way of getting on-line. That means in principle that user doesn't have to show up at all; this particular job could be completely delegated far away. Thus a door is opened in connected robotics and we will witness truly amazing developments. In addition, it will explore the ways in which different robotic “devices” interact with IoT technologies to further develop advanced robotic capabilities.

The Related Work section reviews the recent literature and finds that the IoT technologies have been expanding over these last few years. But research undertaken to date simply focuses on using IoT technologies on nodes so limited in resources they can at most pop up and function, sending data gathered back to its base station. As a result, it is no stretch of the imagination to say that the application of IoT technologies in robotics has received very little attention. That is connected to this her reply. There would seem to be ample demands from different industries for the use of IoT in a robotic application under the banner of Industry 4.0. Therefore, such a controllable and monitoring device as the robotic arm needs must be embedded inside them. In the

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context of this study, a Raspberry Pi is chosen to assist in the implementation of these systems considering that it has more advantages than others. Raspberry Pi is used as controller and web server for the robotic arm. To be more precise, a web server will send one web page at the time to another computer on the same network. The user can then open up the web pages so that they can give commands to tell the robot arm what to do. This project is to implement web server, in order allow control and monitor the robotic arm remotely over existing network infrastructure. Raspberry Pi board is used as the embedded device in this project, while Analog Radio Control (RC) servomotor is employed as the actuator of the designed robot arm. More specifically, Raspberry Pi is designed to control the analog RC servomotor of angle as well as the direction of rotation. Not to mention, it is also used as a web server for remote controlling as well as robotic arm monitoring. It is worth to note that both the hardware and software are involved in this project.

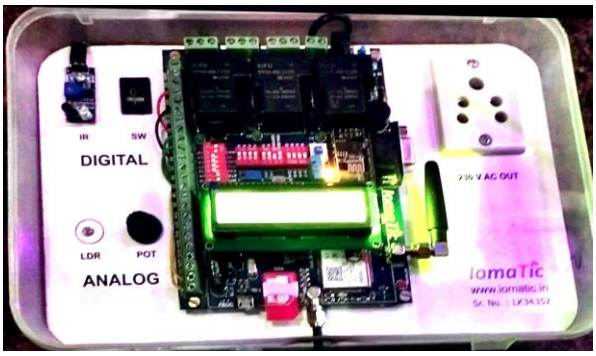

Fig. 1.1 DTMF Controller

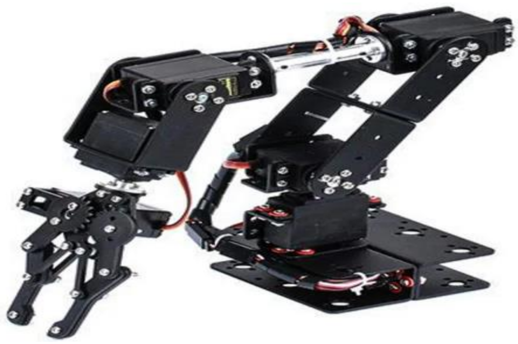

Fig 1.2 Robotic Arm

II. AIM AND OBJECTIVE

To explore the practical application of the Internet of Things (IoT) in the field of robotics, specifically focusing on the development of an Internet of Robotics Things (IoRT) system for remote control and monitoring of a robotic arm using Raspberry Pi as the embedded controller.

III. LITERATURE REVIEW

A robotic arm is a mechanical arm that can be programmed to perform tasks similar to those performed by humans. The robotic arm's primary function is to move an end effector between locations, such as to pick up and transfer various objects.

1. Because of the current IoT revolution and the increasing use of robots in daily operations, Internet of Robotics Things (IoRT) applications are rapidly becoming a reality. IoRT benefits robotic systems by connecting, exchanging, and transmitting distributed computation resources, business activities, context information, and environmental data
2. If the robot is connected to the internet, users can delegate jobs to it remotely via networks; this eliminates the need for the user to be physically present on-site because the job can be completed entirely by the robot. The capabilities of the robotic system are enhanced by IoT technology, which is illustrated with an HMI interface implemented in a smartphone via wireless Wi-Fi connectivity using an ESP32 microcontroller. The arm's objective is to create a low-cost and reproducible robot that assists comprehension of robotics design through project-based learning, from theoretical elements through practical coding and prototype fabrication.
3. The Raspberry Pi serves as the robotic arm's controller and web server. A web server, for example, will provide a web page to another computer on the same network, allowing the user to control the robot arm by accessing the web sites. From the review of some articles and journals, there is some knowledge that can be related to the robotic arm controller based on IoT. The overall thesis mainly focuses on how to control an arm robot. Ankur Bhargava
4. It has been proposed a robotic arm by with 5 DOF. The robotic arm is controlled by an Arduino Uno microcontroller, which receives user input through a set of potentiometers. The arm is made up of four rotating joints and an end effector, with a servomotor providing rotary motion. Each link was created in Solidworks Sheet Metal Working Toolbox and then cut from a 2mm thick aluminium sheet. The arm's final

shape was created by connecting the servomotors and linkages. The Arduino has been programmed to rotate each servo motor in response to the potentiometer shaft's rotation. The nature of the relative movements of a robot's links can be utilised to characterise it. Rahul Gautam

5. It has proposed a robotic arm as well. This type of selective robotic control is essential to tackle challenges such as placing or picking objects that are located a long distance away from the worker. Because the robot's movement can be precisely controlled, the robotic arm has proven a success. Because changing the cable is expensive, it is necessary to design the table to reduce friction in order to increase the time between maintenance. Vaibhav Pawar et al.
6. Refined the robotic arm's design and development using an Arduino controlled robotic arm, allowing it to be put into a robot that can analyse hazardous areas and perform material handling. To investigate those torque properties, we use a humanoid robot arm model and use it to mimic typical object lifting and transferring activities.

IV. METHODOLOGY

The big piece is the robotic arm, which can move things from one spot to another. Control over this movement can be achieved by giving specific commands to move the robotic arm. The robotic arm is furnished with servo motors. These motors help move the arm in the direction needed. The motors are controlled with the help of a micro controller. A web page or an app provides the user interface to control the robotic arm. The control comes over the Internet to the Wi-Fi module. It receives the signal and feeds it to the microcontroller. In fact, the signal that is sent to the robot's arm is actually transferred through their internet connection. So we can control the robot from anywhere on earth. Moreover, for security reasons the web page or the app itself has to require a login ID and a password. Furthermore, to make sure that only one person can command the robotic arm, it must also have its own personal identification number. Such movements made by the robotic arm can be recorded and saved. With this, the same movements can be repeated by the arm whenever necessary.

- **IOT (Internet of Things):**

The Internet of things (IoT) is the internetworking of physical devices. The concept was simple but powerful. If all objects in daily life were equipped with identifiers and wireless connectivity, these objects could be communicating with each other and be managed by computers.

- **The Three C's of IoT:**

Communication -It is the interconnection between the user and system/device.

1. **Control and Automation -** It is programmed once as if any changes in output parameter it will alert the uses and hence it can be control or it can be automated for any particular work.
2. **Cost Savings -** Many companies will adopt IoT to save money. As when a machine loses to fulfill a company product on time the company will lose its money. With new sensor information, IoT can help a company to save money by reducing equipment failure and allowing the business to perform perfectly.

V. MODULES

- **Body Construction of Robotic Arm:**

The construction of the robotic arm body involves the utilization of durable and lightweight materials such as aluminum and carbon fiber, ensuring structural integrity and efficient movement. The structural components, including the base, links, joints, and end effector, are meticulously engineered to enable the robotic arm to carry out complex movements and handle different loads efficiently.

- **Motor Fixing and Control Mechanism:**

High-torque servo motors are selected for their reliability and ability to generate precise movements, ensuring the robotic arm's smooth and accurate operation.

The fixing mechanism involves securely attaching the motors to the robotic arm's structure, ensuring stability and proper alignment to facilitate seamless movement and precise positioning.

The control mechanism incorporates sophisticated algorithms and feedback systems to coordinate the motors' actions, enabling the robotic arm to execute intricate tasks with the required speed, accuracy, and repeatability.

- **Embedded Software Implementation:**

The embedded software is developed using a combination of programming languages such as C/C++ and Python, enabling the robotic arm to interpret commands and perform specific tasks.

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Advanced algorithms are implemented to regulate the robotic arm's movements, ensuring smooth and coordinated operation while accounting for factors such as load capacity, inertia, and environmental conditions. The software architecture includes modules for sensor data processing, motion planning, and error handling, guaranteeing the efficient and reliable functioning of the robotic arm in various operating conditions and tasks.

- **IoT Website Application Development:**

The IoT website application is designed using modern web development technologies, incorporating intuitive user interfaces and responsive design for seamless remote control and monitoring of the robotic arm. Robust security measures such as user authentication, data encryption, and secure socket layers (SSL) are implemented to safeguard the IoT website application from unauthorized access and ensure the privacy and security of data transmission during remote control and monitoring.

VI. MODELING AND ANALYSIS

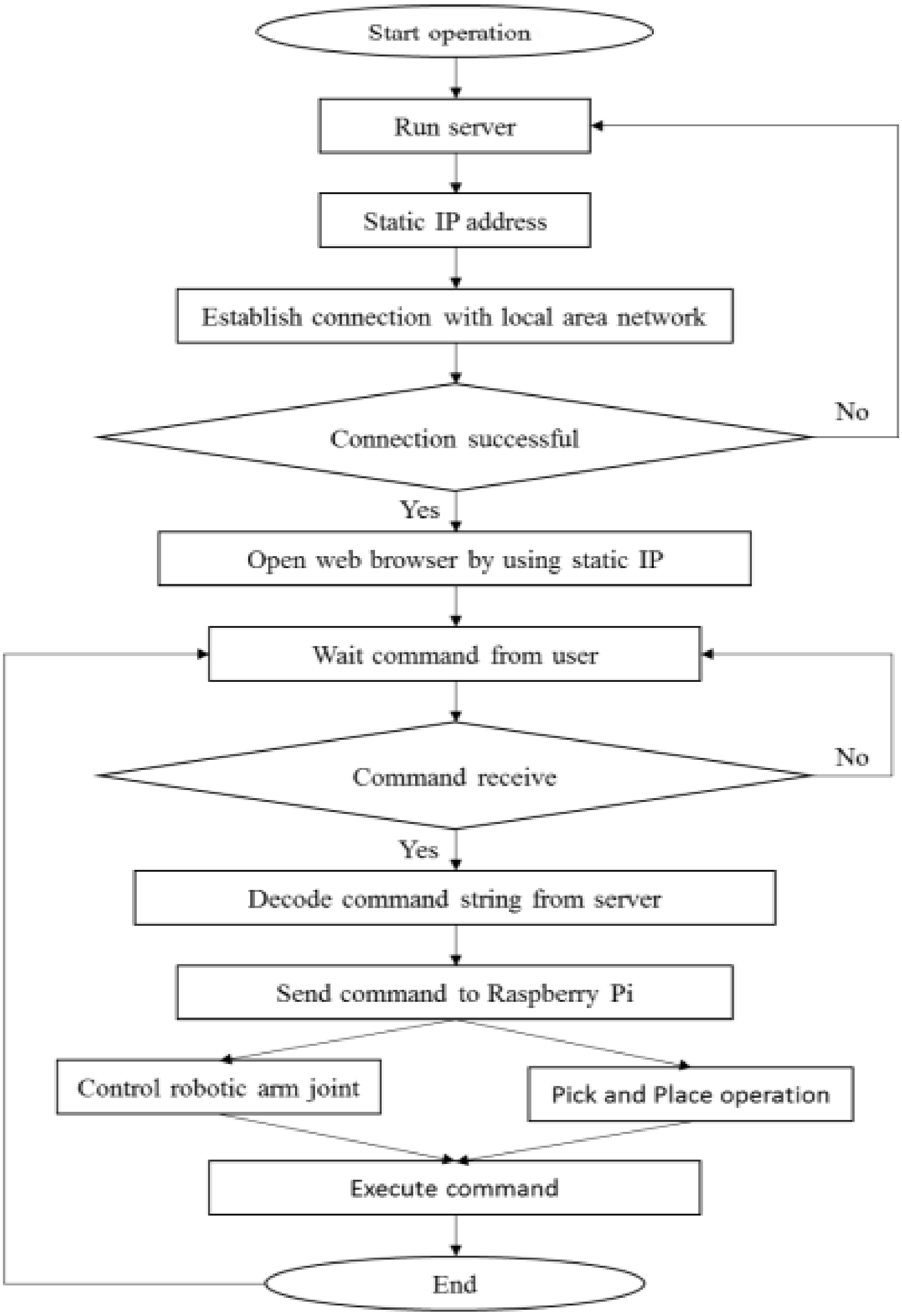

Figure 6.1: DFD of Robotic arm Execution

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This is a block diagram of a robotic arm controlled by an IoT system. The robotic arm is made up of several components, including a motor, a gripper, and a sensor. The IoT system is made up of a microcontroller, a wireless transceiver, and a cloud server.

The microcontroller is responsible for receiving commands from the cloud server and controlling the robotic arm's movements. The wireless transceiver allows the microcontroller to communicate with the cloud server. The cloud server is where the commands are sent from and where the robotic arm's status is monitored. Robotic arm is controlled by the microcontroller, which receives commands from the cloud server through the wireless transceiver. The gripper is used to hold or release objects, while the sensor is used to detect the object's position and orientation.

Overall, this diagram shows how the robotic arm is controlled by the IoT system, which allows for remote control and monitoring of the arm's movements and status.

VII. IMAGES OF WORKFLOW

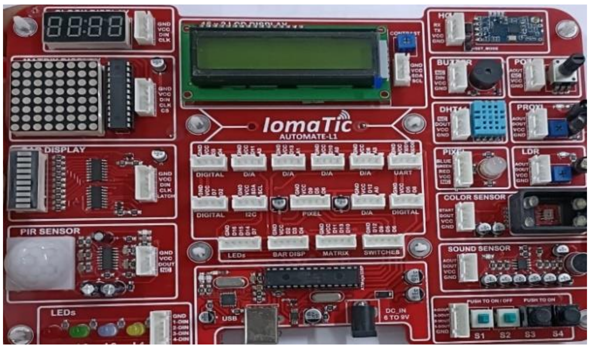

Fig 7.1 Arduino Uno

Fig 7.2 Color Detection Robot

VIII. RESULTS AND DISCUSSION

The project's results may include:

- Performance Metrics: Evaluating the robotic arm's performance based on factors like accuracy, speed, and efficiency.
- User Feedback: Collecting feedback from users to understand their experience and identify areas for improvement.
- Data Analysis: Analyzing the data collected during robotic arm operation to derive insights and optimize the system.
- Cost-Benefit Analysis: Assessing the cost savings and benefits achieved through the use of IoT-enabled robotic systems in different industries.

These resources and considerations will be essential for the development, enhancement, and analysis of IoT-integrated robotic systems and their potential impact on various industries.

IX. CONCLUSION

If the IoT-controlled arm robot is truly a reality, then all industries will be shaken: manufacture, health care and agriculture. A detailed analysis of this technology reveals that it involves a network comprised of sensors, actuators and communications protocols so as to bring together the robot with its environment and enable him to perform complex tasks. Using IoT in robotics, it is possible for the robot to be monitored and controlled remotely in real time. This makes its operation more precise and efficient. It can also be used for predictive maintenance, which reduces breakdowns and the resulting nonproductive downtime. Furthermore, arm robots based on the IoT can be operated from afar and monitored via Internet services. This creates possibilities for telecommuting as well as collaborative creativity and design. Early days yet But the potential is enormous and there is vast room for improvement. Future research could concentrate on improving the performance and dependability of the sensors and communications link, while giving consideration to many new applications in different fields. On balance, the IoT-based arm robot promises numerous fun possibilities for the future of robotics and automation. In particular, the integration with IoT technology can make robots not only cheaper and more flexible to meet different needs, but also largely automated and capable of operating in a variety of

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environments. This report emphasizes the significance and value of this new technology and provides a foundation for more research in this area.

X. REFERENCES

[1] D. J. Joel Devdass Danial, Y.Abhishek Kumar Reddy, J. Uday, 2023, "Intellegent Robot for Real-Time Monitoring and Control using IoT" , Monitor and identify the Rovers, Motor Controller, Geared Motor, Blynk App, ISSN.

[2] Divyanshu Singh, Akanksha Tiwari, Anuj Kumar,2022, "IoT controlled Robotic Arm" Carrying objects using IoT and Placing them on different location, Arduno Uno, Potentiometer, IJSREM.

[3] Jignesh Vinod Patel,2021,"Robotic Manipulator (Robotic Arm)"It is build from aircraft aluminium and can carry light weight material, Servo motor, Motor driver L293D, IJERT.

[4] Victor H. Benitez, Rodrigo Symonds, David E. Elguezabal, 2020 Design of an affordable IoT open- source robot arm for online teaching of robotics courses during the pandemic contingency, HardwareX, Elsevier vol 8 p1 E00158.

[5] Shuangquan Fu and P. Bhavsar, 2019 Robotic Arm Control Based on Internet of Things, IEEE of Long Island Systems, Applications and Technology Conference (LISAT).

[6] Vaibhav Pawar, Sneha Bire, Komal More, Reshma MuleShubham More, 2018 Review on Design and Development of Robotic Arm Generation-1, International Journal of Innovative Science and Research Technology, vol 3

[7] Rahul Gautam, Ankush Gedam, Ashish Zade and Ajay Mahawadiwar, 2017 Review on Development of Industrial Robotic Arm, Journal of Industrial Research & Development vol 4 p3.

[8] Ankur Bhargava and Anjani Kumar, 2017 Arduino controlled robotic arm", IEEE of International conference of Electronics, Communication and Aerospace Technology (ICECA).

[9] M. E. Moran, 2007 Evolution of robotic arms, J. Robot. Surg., vol 1 pp 103–111 P. P. Ray 2017 Internet of Robotic Things: Concept, Technologies, and Challenges, IEEE Access vol 4 p 1–1

[10] P.P. Ray 2017 Internet of Robotic Things: Concept, Technologies, and Challenges, IEEE Access Vol 4 p 1-1