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CONCEPT DEVELOPMENT FOR IOT BASED ROBOTIC ARM

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ABSTRACT

Nowadays, the Internet of Things (IoT) is a rapidly growing field. The Internet of Things (IoT) refers to the use of the internet to connect and control devices. Robotics is another topic that everyone is interested in. Everyone wants to use automated machines because they can perform tasks that we can only dream of. This project involves the creation and construction of a low-cost robotic arm using the Internet of Things. The robotic arm is extremely useful in a wide range of applications, including medical disciplines and industrial automation. With the widespread availability of the internet, controlling and monitoring robots from afar has never been easier. A robotic arm is built in this project to be controlled by an authorised person at any time and from any location using an internet-based application. It's simple to operate gadgets with an Android app. The robotic arm can be controlled in three different ways: slider controlled, voice controlled, and motion controlled.

Keywords*: Internet of things, Robotic Arm, Automation, App development.*

1. INTRODUCTION

A robotic arm is a popularly used and preferred electromechanical machine for many applications in most of the industrial areas. The robotic arm is the product of high-tech automation in the new era. Its advantage is that it can accomplish expected operation through programming and realize remote control. The robotic arm not only has intelligence but also has anti-pressure ability. A robotic arm has similar functions of a human arm, so that can be instead of workers in high-risk environments and highly repetitive work items. Although the robotic arm is not as flexible as the human hand, it can repeat work, and snatch weights, which is far greater than the human hand. It fears neither exhaustion nor danger. As a result, the robotic arm is widely used in a variety of fields. Furthermore, the Internet of Things (IoT), a development of the Internet of Things, enables networking devices to establish communication with people and various "things" via the Internet of Things. Network components, as well as services in distributed computing systems, fall under this category. The Internet and its core are essential to the Internet of Things (IoT). It uses wireless communication technologies to connect the perception layer to the application layer. The Internet of Things (IoT) connects everything to the Internet, exchanges data, and communicates in order to provide control and monitoring. The Internet of Things not only brings convenience to life but also plays a vital role in various fields. The main focus of the work is to apply the Internet of Things technology to the control of the robotic arm and to realize data transmission through MQTT communication protocol. MQTT protocol is a lightweight communication protocol based on the publish/subscribe model, which can realize two-way data transmission. MQTT architecture using Publish / Subscribe is more suitable for use in IoT than other protocols that use Request / Response because the client on MQTT does not require a request update, resulting in bandwidth savings as well as increase in battery life of the device. This protocol is built on the TCP/IP protocol. As a low bandwidth and low consumption communication protocol, it plays an important role in the network layer of the Internet of Things. The control interface is realized through the web page, and users interact with the website by robotic arm graphics. The angle of the servo is obtained by calculating, and the data is transmitted to the MQTT broker. The Robotic side achieves data processing and servo control through Arduino and use ESP8266 to achieve network connection and data transmission.

2. LITERATURE REVIEW

When we talk about robots, many people assume that they are primarily useful in the manufacturing industry or for scientists to test new technology. The primary function of a robot is to assist humans in doing tasks in industries or in everyday domestic duties [1]. This project is the key in which most of the precise [2], work which humans cannot be repeated, is where a robotic arm or we can say a pick n place robot comes into picture [3.] For people who are interested in electronics either as a hobby or as a profession who kind of happens to have more interest in robotics, this project is the key in which most of the precise [2], work which humans cannot be repeated, this is where a robotic arm or we can say a pick n place robot comes Robotics is a branch of mechanical engineering, electrical engineering, and computer science that deals with the design, building, operation, and use of robots, as well as the computer systems that control them, provide sensory feedback, and process data [4-5]. A robotic arm is a mechanical arm that can be programmed in most cases. Similar to a human arm in function; the arm may be the sum [6]. A more complicated robot's complete mechanism or a section of it The internet of things (IOT) is a collection of physical objects, vehicles, buildings, and other items with electronics, software, sensors, actuators, and network connectivity that collect and share data. [7-9]. The Internet of Things (IoT) allows things to be sensed and controlled remotely over existing network infrastructure, allowing for a more direct integration of the physical world into computer-based systems while also increasing efficiency, accuracy, and economic benefit[10-12]. In popular culture, a robot is a machine that appears and acts like a person. The pick-and-place robot

[13-15] is a microcontroller-based mechatronic system that recognises an object and picks it up from its original spot. Using programming codes, an android object detecting application was constructed.

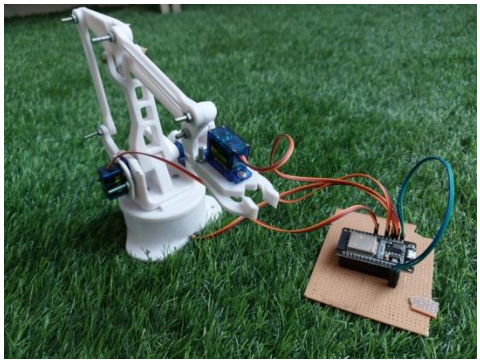
3. PROBLEM STATEMENT

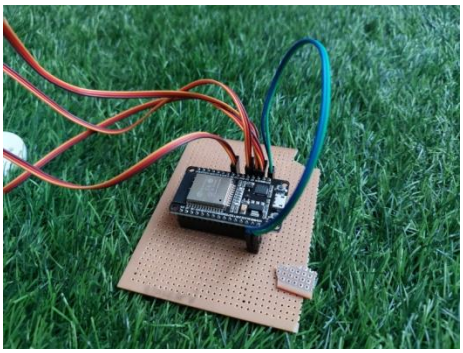
To develop an IoT based Robotic Arm which has the following features:

- Uses power efficiently.
- Works in multiple modes: Slider Controlled, Voice Controlled and Motion Controlled.
- Sends data to server.
- Can be operated from anywhere in the world. Can be operated locally.

4. PROPOSED METHODOLOGY

- This project will use NodeMCU as a microcontroller.
- It will use 4 servo motors for providing 4 Degree of Freedom to the Robotic Arm.
- An Android App will be designed to control the Robotic Arm.
- MIT App Inventor 2 will be used to design the Android App.
- The App will connect to internet and access the cloud server for sending commands to the Robotic Arm.
- The cloud server used for this purpose is a free to use ThingSpeak Cloud Server.
- The robot can be operated in 3 modes – Slider Controlled, Voice Controlled and Motion Controlled.
- In Slider Controlled Mode the robot is controlled using Slider Button.
- In Voice Controlled Mode the robot is controlled using Voice Recognition or Text to Speech Engine.
- In Motion Controlled Mode the robot is controlled using Motion Sensor i.e. Accelerometer and Gyroscope of the phone.





Actual working prototype of Robotic Arm

WORKING

As a microcontroller, Assembly employs NodeMCU. The Robotic Arm has four degrees of freedom thanks to four servo motors. To control the Robotic Arm, an Android App was created. The Android App was created using MIT App Inventor 2. The App connects to the internet and connects to a cloud server in order to deliver commands to the Robotic Arm. ThingSpeak Cloud Server is a free cloud server that was utilised for this purpose. Slider Controlled, Voice Controlled, and Motion Controlled are the three modes in which the robot can be controlled. The robot is controlled via the Slider Button in Slider Controlled Mode. Voice Recognition or a Text to Speech Engine is used to control the robot in Voice Controlled Mode. In Motion Controlled Mode the robot is controlled using Motion Sensor i.e. Accelerometer and Gyroscope of the phone.

5. HARDWARE USED

1. Node MCU

The NodeMCU platform is an IoT platform that is completely free and open source. It comes with firmware for the ESP8266 Wi-Fi SoC from Espressif Systems, as well as hardware for the ESP-12 module. The term "NodeMCU" is used to refer to the firmware rather than the development kits by default. The firmware uses Lua as its scripting language. It's based on the eLua project and was made with the Espressif Non-OS SDK for ESP8266. It includes lua-cjson and SPIFFS, among other open source projects.

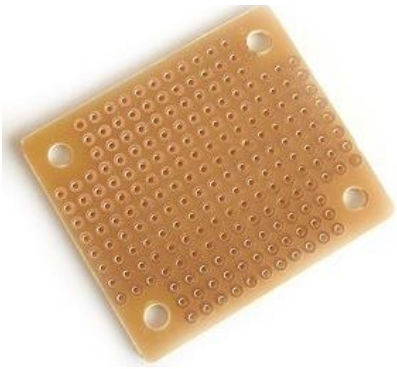
2. Servo Motors SG90

Servo motors are high-torque motors that are extensively employed in robotics and a variety of other applications because their rotation is simple to control. Servo motors, unlike typical DC motors, usually feature a signal pin in addition to the two power pins (Vcc and GND) for control purposes. The signal pin is utilised to turn the shaft of the servo motor to any specified angle. Because servo motors use a lot of electricity, it's vital to connect their power connections to an external power supply when using many servo motors with the Arduino.

3. Power Supply

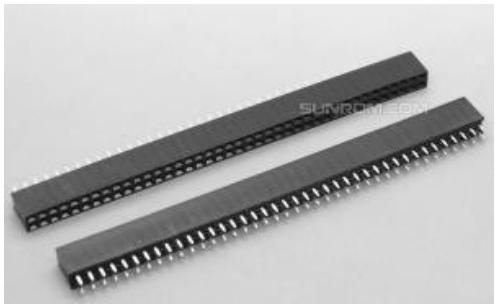
Universal Serial Bus is the abbreviation for Usb. It's a data wire that's used to programme NodeMCU and other micro - controllers. The NodeMCU board is also powered by it. The board receives 3.3V from it.

4. Perf Board



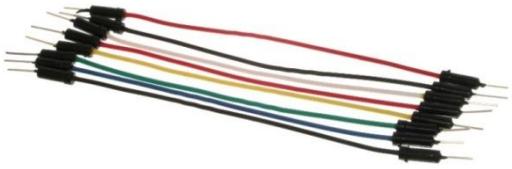
Perfboard is a prototyping material for electronic circuitry (also called DOT PCB). It's a thin, stiff sheet with holes pre-drilled at regular intervals throughout a grid, often a square grid with spacing of 0.1 inch (2.54 mm). Round or square copper pads encircle the holes, but bare boards are also available. Because each pad is electrically separate, the builder uses wire wrap or small point-to-point wiring techniques to connect them. Discrete components such as resistors, capacitors, and integrated circuits are soldered on the prototype board.

5. Header



A pin header is a type of electrical connector that is sometimes abbreviated as PH or simply header. It comprises of one or more rows of male pins spaced 2.54. Pitch is the term used in the electronic community to describe the space between pins.

6. Connecting wires



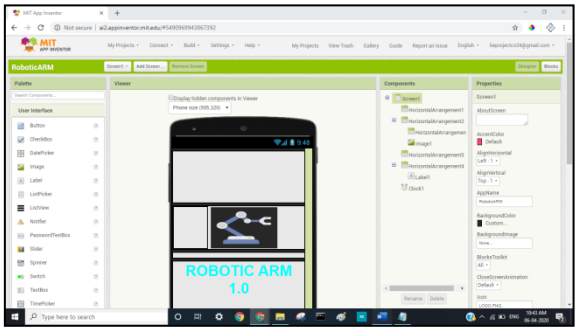
Because electricity requires a medium to travel through, connecting wires allows an electrical current to go from one point on a circuit to another. Copper or aluminium are used to make the majority of the connecting wires. Copper is a low-cost metal with excellent conductivity. Silver, which has a high conductivity but is too expensive to utilise, can be used instead of copper.

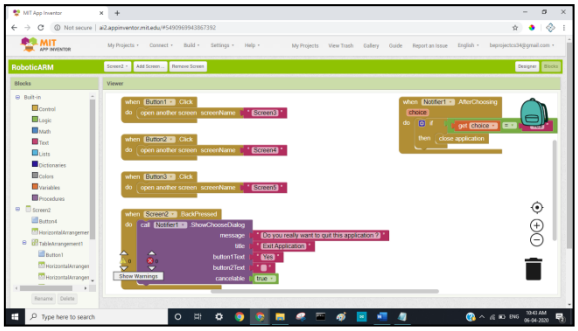
6. SOFTWARE USED

ARDUINO IDE

The Arduino integrated development environment (IDE) is a Java-based cross-platform tool that runs on Windows, Mac OS X, and Linux. It's used to programme the Arduino board and upload them. The IDE's source code is available under the GNU General Public License, version 2. The Arduino IDE has specific code structuring guidelines to support the languages C and C++. The Wiring project is a software library that is included with the Arduino IDE and provides numerous common input and output processes. User-written code only needs two simple functions to start the sketch and run the main programme loop, which are built and linked with a programme stub main() into an executable cyclic executive programme using the GNU tool chain, which is also included in the IDE release.

MIT APP INVENTOR 2





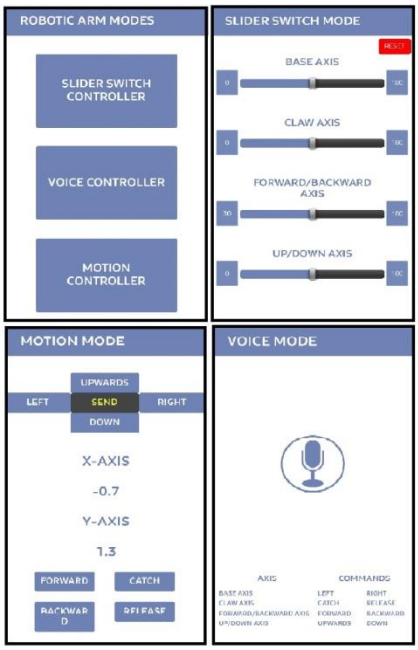
MIT now supports App Inventor, a Google-created web application development environment (MIT). It allows beginners to create application software (apps) for two operating systems (OS): Android and iOS, which are now in final beta testing and will be released to the public in the summer of 2019. It's free and open-source software, with the source code licenced under the Creative Commons Attribution ShareAlike 3.0 Unported Creative Commons Attribution ShareAlike 3.0 Unported Creative Commons Attribution ShareAlike 3.0 Unported Creative Commons Attribution ShareAlike 3.0 Unported licence.

It uses a graphical user interface (GUI) akin to Scratch and StarLogo TNG, which allows users to drag and drop visual objects to create mobile-friendly programmes. To create App Inventor, Google drew on previous research in educational computing as well as internal Google work on online development environments.

App Inventor and the projects on which it is based are informed by constructionist learning theories, which emphasise that programming may be used to engage powerful ideas through active learning. As such, it is part of a bigger movement in computers and education that began with Seymour Papert and the MIT Logo Group's work in the 1960s. It uses a graphical user interface (GUI) akin to Scratch and StarLogo TNG, which allows users to drag and drop visual objects to create mobile-friendly programmes. To create App Inventor, Google drew on previous research in educational computing as well as internal Google work on online development environments.

THINGSPEAK CLOUD

ThingSpeak is an open-source Internet of Items (IoT) application and API that uses the HTTP and MQTT protocols to store and retrieve data from things over the Internet or a Local Area Network, according to the makers. ThingSpeak allows developers to create sensor recording apps, location tracking apps, and a social network of things with status updates ".. ThingSpeak was first introduced by ioBridge in 2010 as an IoT application support service. ThingSpeak now includes compatibility for MathWorks' MATLAB numerical computing tools, allowing ThingSpeak users to analyse and visualise submitted data without having to purchase a Matlab licence from MathWorks. Mathworks, Inc. and ThingSpeak have a close working partnership. In reality, the Mathworks' Matlab documentation site has absorbed all of the ThingSpeak content, allowing registered Mathworks user accounts to be used as legitimate login credentials on the ThingSpeak website. ThingSpeak.com's terms of service and privacy policy are a contract between the user and Mathworks, Inc. ThingSpeak has been featured in Instructables, Codeproject, and Channel 9 as well as other specialist "Maker" websites.



Actual Photos of Working Application Developed.

APPLICATIONS

- Bio-Medical Applications.
- Industrial Applications.
- Mechanical Applications.
- Educational Purpose.

FUTURE SCOPE

- We can create our own remote server instead of using ThingSpeak Cloud Server.
- We can create a web interface application too with a camera to remotely view the operations of Robotic Arm.

7. CONCLUSION

The prepared mechanism has been successfully constrained and executed to carry out the required work of picking up the weight of the object like box and put them in to placed at different location. This robot can be modified using some of latest techniques to make it more flexible and addition of IP cam app invented by MIT is helpful for continuous monitoring of the Robotic arm by the user. The designed dimensions length is 12cm and it as a load bearing capacity of around 200g. The pick and place robot being implemented to ease process of sorting. This can be helpful to various industrial application where machines need to be controlled from distant places. Virtually reality concept can also be included in this implemented to explored the human accessibly region.

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