IOT Based Gesture Movement Recognize Robot

Abhishek Deendayal Patil
Department of E & TC Engineering,
Bharti Vidyapeeth's COE Lavale, Pune

Husban Imtiyaz Kadiri
Department of E & TC Engineering,
Bharti Vidyapeeth's COE Lavale, Pune,

Ajinkya Shriram Joshi
Department Of E & TC Engineering,
Bharti Vidyapeeth's COE Lavale, Pune

Atul B Wani
Assistant Professor,
Department of E & TC Engineering,
Bharti Vidyapeeth's COE Lavale, Pune

Abstract

Robots are playing a vital role in today's industrial automation and monitoring system. As technology developed these robots have increased their applications and functionality. Working robots will cooperate to the people makes the work more Effortless and uncomplicated. This paper provides 4 different gestures for controlling the robots, i.e., forward, backward, left, right. For cutting weeds a gripper concept using buttons is anticipated. These movements are given by the user using MEMS Sensor. The MEMS Sensor will be set to the hand. Whenever the hand moves in some direction, the mechanical movement of the hand will be recognized by MEMS. MEMS translate this mechanical hand movement into equivalent electrical signals and send it to the Raspberry Pi. The Raspberry Pi at the transmitter side sends control signals to the receiver side through IOT (Internet of Things). The controller (ARM7) at the receiver area receives these signals and gives direction to the robot through IOT i.e. through cloud.

Keywords: IOT (Internet of Things) MEMS-Micro Electro Mechanical System, ARM7 Microcontrollers, Wireless Fidelity (Wi-Fi), Robotic Arm.

I. Introduction

In today's age robotic has the fundamental key for new invention. The development of human-machine communications on an everyday basis has made the people to utilize the technology. Instead of giving rational methodology physical methods have been welcomed by everyone. Coding to some 100's of pages requires more instance, capital and power so to overcome that gesture recognition is enhanced. Using gesture recognition coding can be easily made by everyone. For gesture recognition many active devices such as a "trackball, remote, joystick and touch tablet" are in practice1. Some of the devices are used for giving motion recognizer but gesture

ISSN: 2278 – 7798

recognition has the foremost utility. So gesture recognizer like accelerometers with 3-axes is extensively used. Gesture can be captured by wearing gloves or having wrist band attached with the MEMS whereas using vision system and data glove is very expensive hence not utilized. To have a balance of precision data collection, “Micro Inertial Measurement Unit” is developed for recognizing the gestures in 3 dimensional axis x, y, z.

Gesture can be recognized by following approaches comprises of “template-matching, arithmetical toning, vocabulary lookup, linguistic matching, and neural arrangement”. But in this paper the gesture recognition models are based on the signal succession3 and pattern toning. The gesture values are mapped by extracting a simple characteristic based on signal succession of acceleration, for achieving high efficiency and accuracy. For this type of methodology the MEMS accelerometer is used to give the hand gestures. MEMS acronym micro electro mechanical system which has 3 axis of x, y, z and a power supply port with ground is fabricated. MEMS use the knowledge which is known as “micro-fabrication knowledge”. Has “cavity, holes, channels, membranes, cantilevers and furthermore imitates motorized parts”. The highlighting of MEMS is silicon fabrication acquires moisture. The enlargement of micro technology has many features like size, efficiency and capital. For a large scale device micro fabrication is used because of its smallness, applicability and lessening of material utilization. Micro technology and electronics have great scope of innovation. MEMS can be mounted on the Raspberry Pi.

In this project two Raspberry Pi is used to interface with IOT and MEMS. The **Raspberry Pi** board is a miniature marvel, packing considerable computing power into a footprint no larger than a credit card. It’s capable of some amazing things, but there are a few things you’re going to need to know before you plunge head-first into the bramble patch. The processor at the heart of the Raspberry Pi system is a Broadcom BCM2835 system-on-chip (SoC) multimedia processor.

This means that the vast majority of the system’s components, including its central and graphics processing units along with the audio and communications hardware, are built onto that single component hidden beneath the 256 MB memory chip at the center of the board. The Raspberry Pi is sent MEMS instruction to recover side through Internet or wireless medium. Gesture instructions are given using MEMS which is attached in the wrist band. The gestures used to move the robot in all possible directions in the environment are Forward, Backward, Right, Left and Arm movement through IOT. Special movements for arm in enhanced with the gripper.

For more convenience button system is introduced to do the task often occurring. The output gesture production depends on the gesture input different output gesture is generated for every possible gesture input. DC motors attached to the robotic wheels is driven using the relay. The control signals will activate the robotic DC gear motor to move the robot. Similarly the DC motor connected with robotic arm will receive the control signal.

ISSN: 2278 – 7798

II. Literature survey

Robotics

Automation is defined as a technology that is concerned with the use of Mechanical, electronic, and computer-based systems in the operation and Control of production. This technology includes transfer lines, mechanized Assembly machines, feedback control systems, and robots. There are three Broad classes of industrial automation: fixed automation, programmable Automation, and flexible automation. Of these three types, robotics coincides most closely with programmable Automation. The robot can be programmed to move its arm through a sequence of motions in order to perform some useful task. It will repeat. That motion pattern over and over again until reprogrammed to perform. Some other task. Hence the programming feature allows robots to be used for a variety of different industrial operations, many of which involve the Robot working together with other pieces of automated or semiautomatic Equipment. These operations include machine loading and unloading and many more.

Robot Anatomy

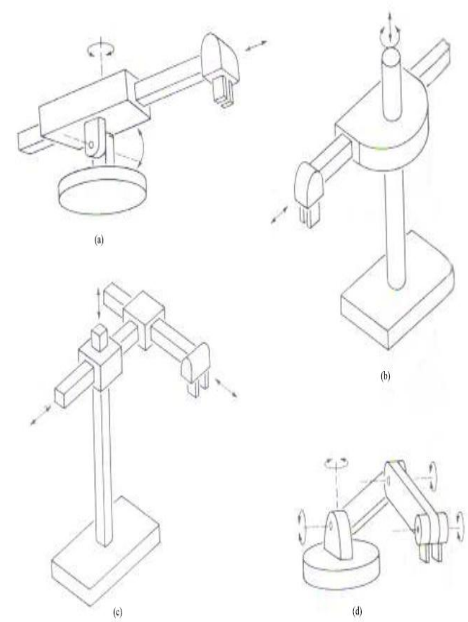
Common Robot Configurations

The vast majority of today's commercially available robots possess one of The four basic configurations:

- Polar configuration
- Cylindrical configuration
- Cartesian coordinate configuration
- Jointed-arm configuration

Robot Motions

The robots movement can be divided into two general categories: arm and Body motions, and wrist motions. The individual joint motions associated with these two categories are sometimes referred to by the term "degrees Of freedom", and a typical industrial robot is equipped with 4 to 6 degrees of freedom. Here we use Robotic Arm for Pick and Place purpose.



The four basic robot anatomies: (a) polar, (b) cylindrical, (c) Cartesian, (d) jointed arm.

Internet of Things (IOT)

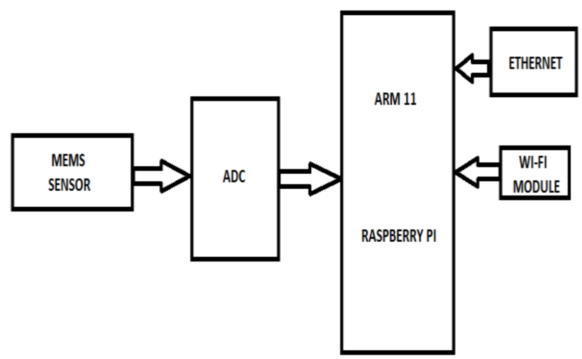
There is no unique definition available for Internet of Things that is acceptable by the world community of users. In fact, there are many different groups including academicians, researchers, practitioners, innovators, developers and corporate people that have defined the term, although its initial use has been attributed to Kevin Ashton, an expert on digital innovation.

ISSN: 2278 – 7798

What all of the definitions have in common is the idea that the first version of the Internet was about data created by people, while the next version is about data created by things. The best definition for the Internet of Things would be: "An open and comprehensive network of intelligent objects that have the capacity to auto-organize, share information, data and resources, reacting and acting in face of situations and changes in the environment" Internet of Things is maturing and continues to be the latest, most hyped concept in the IT world. Over the last decade the term Internet of Things (IoT) has attracted attention by projecting the vision of a global infrastructure of networked physical objects, enabling anytime, anyplace connectivity for anything and not only for any one. The Internet of Things can also be considered as a global network which allows the communication

Between human-to-human, human-to-things and things-to-things, which is anything in the world by providing unique identity to each and every object. IoT describes a world where just about anything can be connected and communicates in an intelligent fashion that ever before. Most of us think about "being connected" in terms of electronic devices such as servers, computers, tablets, telephones and smart phones. In what's called the Internet of Things, sensors and actuators embedded in physical objects—from roadways to pacemakers—are linked through wired and wireless networks, often using the same Internet IP that connects the Internet. These

Networks churn out huge volumes of data that flow to computers for analysis. When objects can both sense the environment and communicate, they become tools for understanding complexity and responding to it swiftly. What's revolutionary in all this is that these physical information systems are now beginning to be deployed, and some of them even work largely without human intervention. The "Internet of Things" refers to the coding and networking of everyday objects and things to render them individually machine-readable and traceable on the Internet. Much existing content in the Internet of Things has been created through coded RFID tags and IP addresses linked into an EPC (Electronic Product Code) network.



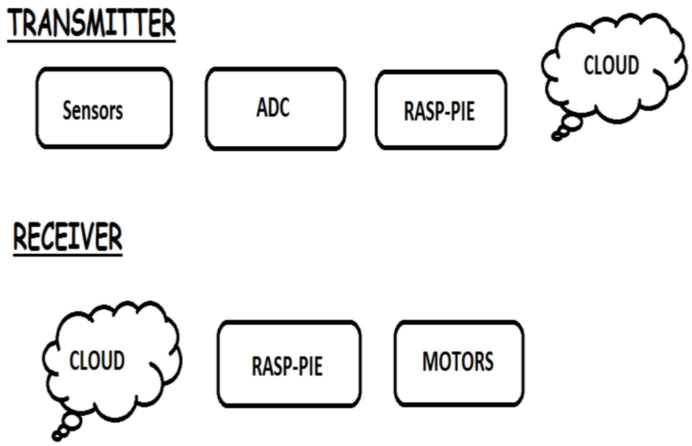
III. Block Diagrams

Following block diagram shows all the elements of our system. It contains the mainly five elements which are as follows

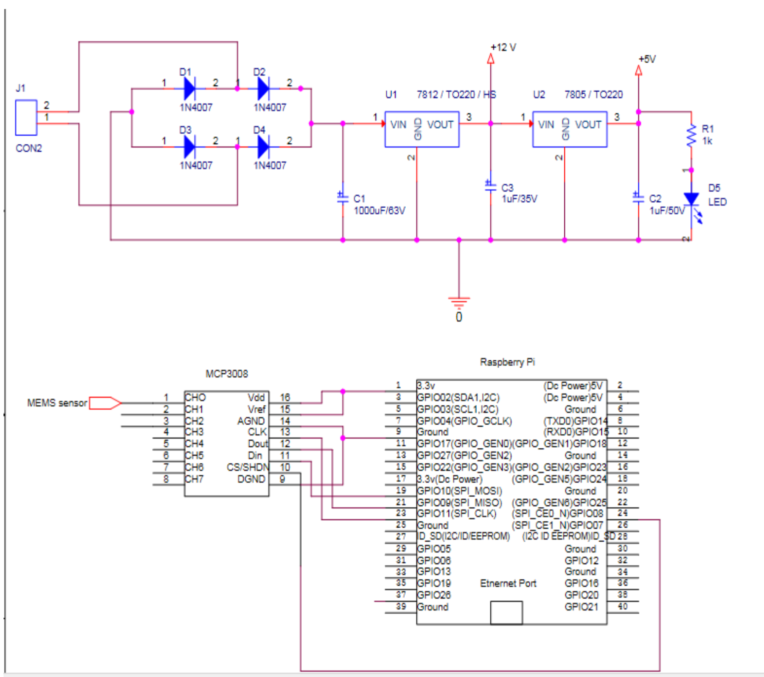
- MEMS Sensor
- Raspberry Pi
- Analog to Digital Converter

ISSN: 2278 – 7798

- Wi-Fi Module



- Cloud Storage



IV. Circuit Diagram

V. Working

This is a prototype of a pick and place robotic arm controlled over the internet are two modules used here:

1. Module -core-1: This interprets the user's gestures to control the robot, translates the gestures as text commands and sends it over the cloud to Module-Core-2

2. Module-core-2: This module receives the control commands from core-1 and activates the robotic arm accordingly.

Since the commands can be sent over the internet the control commands can be sent from any part of the world with an internet access. This gives us the power to employ the robot in remote, isolated and dangerous environments. It can also be used in industrial automation.

ROBOTIC ARM: Robotic arm has been used in this project. Three motors of the robotic arm are controlled using motor drivers and a module core (Core-2). Two H-Bridge modules based on L298N are used to drive the motors using a 9V power supply.

In the robot, the bottom most motor or the shoulder motor is used for horizontal (left - right) motion. The middle one or the elbow motor is used for vertical (up-down) motion. The motor at the tip (the hand) is used to control grab-release motion. The robotic arm module is controlled by Core-2.

Remote Control Module: This module uses a Module Core (Core 1). Interfaced with two accelerometers which are used like joysticks to send commands to the robotic arm.

Accelerometer-1 senses the movement controls such as right, left, up and down

Accelerometer-2 senses the grab and pick controls

ISSN: 2278 – 7798

The user gestures are captured as commands and published as events usingSpark. Publish (). Module-Core 2, explained above, which controls the motors, subscribes to the events published by this Module core.

The control of the arm is based on the tilt measured by the accelerometer. For example if the Accelerometer-1 is tilted to left then the command to be published is 'left'.'

Processing and Data Capture System with Wi-Fi

The capture and data processing system was developed with the C++ programming language, including the libraries for the communication protocols, such as: DHCP and HTTP that belong to the application layer in the OSI model. TCP was used in the transport layer. The wireless communication between the sensors and the router is established using the Wi-Fi libraries (slightly modified) of the capture and data processing system to identify the SSID and the password for the WPA or WEP security protocol that is being connected to the Wi-Fi shield. Finally, the programming necessary to send all the parameters to the cloud was done. The process of sending the data to the Internet has different phases. Initially the temperature is captured by the thermocouple and passed to the (Integrated Circuit) IC MAX 6675 which performs the cold junction compensation (it compensates the dependence with the environmental temperature inherent to the measure), amplifies and converts to digital the temperature obtained from the thermocouple. The MAX IC passes the data to the microcontroller ATMEGA 328P through the following serial port: SPI of 12 bits and 0.25 centigrade grades of resolution. Lastly, the microcontroller passes the data to the Wi-Fi wireless shield that sends the information to a wireless router.

Analysis of Dataflow

Path chart [18] is a Linux utility similar to traceroute but focused in the network performance measurements. The output of the Path chart software is shown in Table. This output shows the measurements of the possible paths that the data can take when traveling from a sensor to the cloud servers. The information is analyzed with all the metrics among the hops involved the source of the packets (sensor) to the destination of the packets (IoT web portal - Lively). The

Link	Host	IP	BW	Latency	Drodped	Queuing
0	System of processing and capture of Data Wi-Fi	192.168.0.3	39 Mb/s	124 µs		
1	Modem Wi-Fi	192.168.0.1	722 Kb/s	14.8 ms	11 %	
2		10.32.0.26				
3		*201.244.1.150				
		*10.5.4.70				
		*201.244.1.5		490µs		
4	sta.etb.net.co	10.5.4.74		27ms		
5	Edge3.Miami1	4.59.82.113				
		*4.69.138.77		73 µs	42%	
6	Edge2.Miami2	4.69.138.109	571Mb/s	345 µs		1.23 ms
7	globalcrossing	4.68.111.122	178 Mb/s	156 µs		
8	ae9.scr4.gblx.net	67.16.147.129		30.1 ms		
9	po2.gblx.net	67.17.95.214		161 ms		
10	INTERNAP	64.215.30.78				
		*216.52.255.46	49 Mb/s	4 µs		1.55ms
11	pnap.net	216.52.255.110		135 ms		
12	Logmein.net (xively)	63.251.195.114				
*		210.52.233.121				

ISSN: 2278 – 7798

tool sends 45 different packets sizes in the range from 64 to 1500 bytes (1500 is the MTU in the local host). The software uses 32 different sets of this packets per hop. Thus, 11.520 packets are sent and the same number of answered are shown by the software.

VI. MEMS Sensors

A Sensor is a device that measures a physical quantity and changes it into an electrical signal. Sensor plays a major role in MEMS and can be used in arrangements with other sensors for multi-sensing applications. These sensors are classified into three types:

- MEMS Pressure Sensors
- MEMS Chemical Sensors
- MEMS Inertial Sensors (gyroscopes, accelerometers)
- MEMS sensor is generally designed by a similar masking process as used in microchips. The MEMS sensor is an accelerometer used to measure acceleration.
- Nowadays remote robots control is performed by using a cell phone or a remote or by a wired connection. If we think about hardware and cost for low-level applications, all such things increase the complexity. The robot that we have designed in this context is the one which is different from this. It doesn't have the need of any remote or communication module.
- This robot consists of three parts such as microcontroller, MEMS sensor and Motor driver. This is MEMS based hands gesture controlled robot which is self-activated and controlled by hand gestures. In this project, the MEMS is set to the hand which includes an acceleration meter. Whenever the hand moves in any direction, the MEMS recognizes the mechanical movement of the hand and converts this movement into electrical signals and sends it to the microcontroller.
- At the transmitter side, the microcontroller receives the electrical signals and sends equivalent signals to the receiver end through an RF transceiver. At the receiver end, the microcontroller receives the signals from the RF transceiver and finally a motor driver is used to control the motor.
- In future, we will design a wireless robot capable of sensing hand gestures by using wireless technology. It can be used in military applications as a robotic vehicle. Please leave your comments about the MEMS based robot applications in the comments section below and your views for further advancement.

ISSN: 2278 – 7798

VII. EXPERIMENTS

In the area of safety, for example, many machines require operators to place each hand on a control switch before the controller starts any action. Instead of having operators move their hands to special switches, why not simply let them hold up their hands with a gesture sensor?

This type of control could improve productivity, reduce the effects of repetitive motions, and improve safety. Advanced robotic arms that are designed like the human hand itself can easily controlled using hand gestures only. The arm controller wears the sensor gloves and the robotic arm will mimic the movement of the controller. Advanced robotic arms like these can perform complex and hazardous tasks with ease. Proposed utility in fields of construction, hazardous waste disposal, and medical sciences.

VIII. CONCLUSION

We proposed a fast and simple algorithm for hand gesture recognition for controlling robot using IOT and wireless network. In our system of gesture controlled robots, we have only considered a limited number of gestures. Our algorithm can be extended in a number of ways to recognize a broader set of gestures. The gesture recognition portion of our algorithm is too simple, and would need to be improved if this technique would need to be used in challenging operating conditions. Reliable performance of hand gesture recognition techniques in a general setting require dealing with occlusions, temporal tracking for recognizing dynamic gestures, as well as 3D modelling of the hand, which are still mostly beyond the current state of the art.

IX. REFRENCES

[1] Y. Huang and G. Li, “Descriptive models for internet of things,” in Intelligent Control and Information Processing (ICICIP), 2010 International Conference on, 2010, pp. 483–486.

[2] L. Hour and N. Bergmann, “Novel industrial wireless sensor networks for machine condition monitoring
and fault diagnosis,” Instrumentation and Measurement, IEEE Transactions on, vol. 61, no. 10, pp. 2787–2798, 2012.

[3] Z. Key, L. Yang, X. Wang-hui, and S. Heejong, “The application of a wireless sensor network design based on zigbee in petrochemical industry field,” in Intelligent Networks and Intelligent Systems,
2008. ICINIS ’08. First International Conference on, 2008, pp. 284–287.

[4] G. Cena, A. Valenzano, and S. Vitturi, “Wireless extensions of wired industrial

ISSN: 2278 – 7798

communications networks," in Industrial Informatics, 2007 5th IEEE International Conference on, vol. 1, 2007, pp. 273–
278.

[5] K. Koumpis, L. Hanna, M. Andersson, and M. Johansson, "Wireless industrial control and monitoring beyond cable replacement," in Proc.2nd PROFIBUS Int. Conf., Coombe Abbey, Warwickshire, UK,
2005.

[6] S. Trikaliotis and A. Gnad, "Mapping wirelesshart into profinet and profibus fieldbusses," in Emerging
Technologies Factory Automation, 2009. ETFA 2009. IEEE Conference on, 2009, pp.

[7] Siemens, "Profinet the industrial Ethernet standard for automation," 8th IEEE International Workshop on Factory Communication Systems COMMUNICATION in AUTOMATION, 2007. [Online]. Available:
http://wfcs2010.loria.fr/files/Siemens.pdf

[8] D. Miorandi, E. Uhlemann, S. Vitturi, and A. Willig, "Guest editorial: Special section on wireless
Technologies in factory and industrial automation, part i," Industrial Informatics, IEEE Transactions on, vol. 3, no. 2, pp. 95–98, 2007.

[9] J. Antony, B. Mahato, S. Sharma, and G. Chitranshi, "A web plc using distributed web servers for data acquisition and control: Wed based plc," in Information Science and Applications (ICISA), 2011 International Conference on, 2011, pp. 1–4

.

[10] J.-S. Lee and P.-L. Hsu, "An improved evaluation of ladder logic diagrams and petri nets for the sequence controller design in manufacturing systems," The International Journal of Advanced Manufacturing Technology, vol. 24, no. 3-4, pp. 279–287, 2004. [Online]. Available:
http://dx.doi.org/10.1007/

[11] R. Zurawski and M. Zhou, "Petri nets and industrial applications: A tutorial," Industrial Electronics, IEEE Transactions on, vol. 41, no. 6, pp.567–583, 1994.

[12] L. Gomes, A. Costa, J. Barros, R. Pais, T. Rodrigues, and R. Ferreira, "Petri net based building automation and monitoring system," in Industrial Informatics, 2007 5th IEEE International Conference on, vol. 1, 2007, pp. 57–62.

[13] X. Fu, Z. Ma, Z. Yu, and G. Fu, "On Wireless sensor networks formal modeling based on Petri nets," in Wireless Communications, Networking and Mobile Computing (WiCOM), 2011 7th International
Conf.

[14] J. CERVANTES, "Representacion y aprendizaje de conocimiento con redes de petri difusas," 2005.

[15] Corso, F.; Camargo, Y.; Ramirez, L., "Wireless Sensor System According to the Concept of IoT - Internet of Things-," Computational Science and Computational Intelligence (CSCI), 2014 International Conference on , vol.1, no., pp.52,58, 10-13 March 2014

ISSN: 2278 – 7798