# Role Of Arduino In Real World Applications

**Kuldeep Singh Kaswan, Santar Pal Singh, Shrddha Sagar**

**Abstract**: Arduino is the physical programmable board. A wide array of sensors can be attached with this board and many third-party libraries can be linking with an Arduino sketch. Arduino hardware components are cheaper in relation with other controller architecture and programming language is easy. Arduino has greater academic applications. In this paper, the roles of Arduino among microcontroller boards are investigated. First, different types of Arduino boards are identified. Second, different Arduino applications are identified from the literature reported in the literature are surveyed and analyzed. In the last we will also summarize the work done.

**Index Terms**: Fuzzy Logic (FL), Neural Networks (NN), Genetic Algorithm (GA), Bee Colony Optimization (BCO)

————————————————  ◆  ————————————————

## 1. INTRODUCTION

Arduino is an open source programmable board. It is very easy to use and powerful single board computer that has gained considerable traction in the hobby and professional market. It consists an Integrated Development Environment (IDE) where one can write and run the programs and these programs are known as sketch in arduino and a microcontroller. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

## 2 ARDUINO BOARD

Arduino boards are physical programmable board that are used for flexible programming, customizable signal types and easy adaptation to the existing installations can offer many benefits to world. A variety of boards are available in the market as shown in Fig.1.
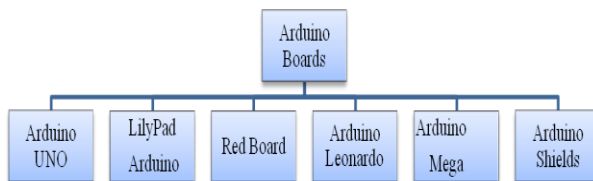


**Fig. 1.** *Classification of Arduino board*

### 2.1 Arduino UNO

Arduino UNO is the commonly used board that is also known as classic Arduino. This board has 14-digital I/O pins, where 6-pins can be used as PWM, 6-analog inputs, a reset button, a power jack, a USB connection and more. This board can receive and send information over the internet with the help of Arduino shields [1].

————————————————————

- *Kuldeep Singh Kaswan, Associate Professor, School of Comp. Sc.& Engg., Galgotias University, Greater Noida (India)*
- *Santar Pal Singh, Associate Professor, School of Comp. Sc.& Engg., Galgotias University, Greater Noida (India) Corresponding author          E-mail: spsingh78@gmail.com*
- *Shrddha Sagar, Associate Professor, School of Comp. Sc.& Engg., Galgotias University, Greater Noida (India)*

### 2.2 LilyPad Arduino

The first version of this kit was introduced in 2006 [2]. This programmable board is a wearable e-textile technology. This board also contains of I/O, power, and also sensor boards which are built especially for e-textiles. These are even washable.

### 2.3 Red Board

It Windows 8 based board that can be used without changing the security settings. Due to the USB or FTDI chip this board is more constant. It is completely flat on the back side.

### 2.4 Arduino Leonardo

For input and output ports than the Arduino UNO, one can use this board, but do not need the horsepower or size of the Due. This board has a micro-USB adapter instead of the Uno's full-size USB port.

### 2.5 Arduino Mega

For The Arduino Mega is similar to the UNO's big brother. This board has the same 5V power supply as the Uno. Most of the Arduino shields are also compatible with the Mega.

### 2.6 Arduino Shields

For Arduino Shields are boards that connect to a number of different Arduino models. This board has many features such as wireless network access, cell access, or the ability to prototype circuits.

## 3 ARDUINO APPLICATIONS

Arduino boards are playing very important roles in many disciplines today [3],[4]. In this section, we have discussed about different Application areas of Arduino as shown in Fig.2..



**Fig. 2**. *Arduino applications in different areas*

### 3.1 Smart Homes
With Arduino boards we can control the home activities with the control systems such as motion sensors, outlet control, temperature sensors, blower control, garage door control, air flow control, sprinkler control and bill of materials [5].

### 3.2 Defence
With RADAR (Radio Detection and Ranging) is a radio waves-based object-detection system that can find out the range, altitude, direction, or speed of objects. A Radar can have different sizes and have different performance specifications. [6]. It be used for air-traffic control at airports, long range surveillance and early-warning systems in ships. This system is the heart of a missile guidance system. In war a number of small portable radar systems are maintained and operated, as well as systems that occupy several large rooms [7].

### 3.3 Industries
Due to the easy programming environment, signal types, and easy adaptation in new set up, Arduino is used in Many industries. Arduino boards are low cost, and flexible alternatives to the usual industrial devices for adding remote control and monitoring functionality to small legacy industrial systems. With the growth of wireless technologies such as Wi-Fi and cloud services in few past years, the wireless systems become monotonous in our daily life [8].

### 3.4 Traffic Signal Control
Today Arduino is used for the control of traffic lights, it can also be used for the real time control system with programmable timings, pedestrian lighting etc. [9]. In traffic control system the junction timing adjusts automatically to accommodate movement of vehicles smoothly avoiding waiting time at junction.

### 3.5 Medical
An Arduino based heartbeat monitor counts the number of heartbeats in a minute. In this a heartbeat sensor module is attached that senses the heartbeat upon putting a finger on the sensor [10]. Arduino is used for designing many medical equipment's such as customizable Breathalyzer, little automatic slipper foot massager, Open source EEG/ECG/EMG, Thermometer, WI-Fi Body Scale with Arduino Board etc.

### 3.6 Laboratories
In laboratory for the designing and learning circuit designing Arduino provides a useful platform. There may be chances of some damages or any something wrong by the beginners and it may also be costly for the students to use new electronic parts. In this Arduino Simulator offers a solution to these problems, no damage done to your components, no money spends on hardware, faster circuit prototyping and no mess with cabling at all [4], [11]. Arduino based automated slide movement microscope is very cost-effective laboratory device.

### 3.7 Body Control with Arduino
With There are many body control devices with Arduino used for health care such as handSight gloves, breathalyzer microphone, heart rate monitoring system etc. Arduino based heart rate monitor is more advanced than a simply measure a user's heart rate. Our heart rate monitors talks! Each button gives a verbal description of its functionality and makes the measurements visible on the screen. This monitor will save the last four readings, display them, average them, and also offer some inspirational quotes [3]. This sensor is used for fever, hypothermia, and activity levels and patterns detections [15]. This device can sense the facial expressions. With the help of this Arduino device we can find out breathing rate, breathing depth, activity level and arousal level [12]. For the movement monitoring we use this Arduino device, it can detect the occurrence of muscle contractions and strength of muscle contractions. We can check organ health and arousal and it can be used for diagnostic for medical intervention and enhance social interaction [13], [14]. Electroddermal Activity: Another name of this sensor is Galvanic Skin response (GSR), used for emotional and physical arousal. Eye trackers are utilized as a part of exploration on the visual framework, in brain research, in psycholinguistics, showcasing, as an information gadget for human PC cooperation, and in item plan [16]. In HandSight sensors are used to sense lights, find distance of physical objects. In the breathalyzer microphone there is collection of blood-alcohol content level data sets. It can also easily be adapted for karaoke [17].

### 3.8 Aerospace
Classical control theory to an airplane flap model and integration of RC vehicles in a Robotic Arena [18], [19].

### 3.9 Automatic Vehicle Control
In this paper a test bed infrastructure designed for vehicle driving that includes control-system experimentation, strategies, and sensors [19]. These four facilities and instruments.

## 4 ANALYSIS AND DISCUSSIONS
In this section we summarized different application areas of Arduino Boards. Also summarized each application used to implement these applications. Arduino boards are used in different forms for different areas as shown in Table 1.
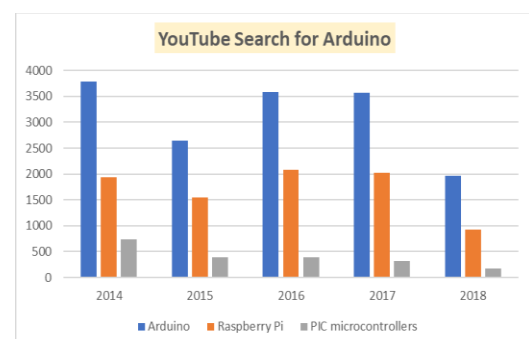
**Fig. 3.** *Comparative analysis based on You Tube search.*

Popularity of Arduino can be measured on the behalf of the result extracted by Google Trends in Fig. 3. In this figure three programming boards Arduino, Raspberry and PIC microcontrollers are compared, this data is all the YouTube searches world widely used by all the categories. Main result extracted from this is, Arduino is the most used controller board while PIC is least used over the past five board. Fig. 4 is the second parameter for measuring the popularity of Arduino. This data is extracted by Google Trends, it has web search record for programming boards Arduino, Raspberry and PIC microcontrollers. This data is the entire web searches world widely from all the categories. Main result can be extracted from this is that Arduino is the most used controller board in all the past five years and inn2018 it is maximum searched, while PIC is least used over the past five board.
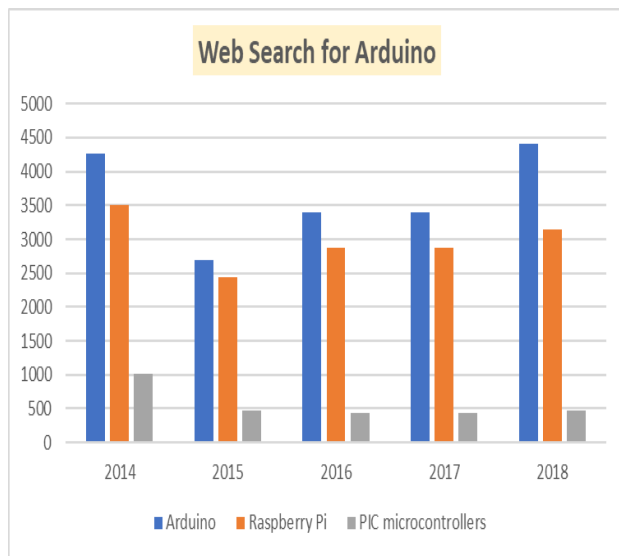


**Fig. 4**.*Comparative analysis based on web search.*

## 5 CONCLUSION

There are number of application areas for Arduino board, we highlight as many references as possible, however it may also be possible that we missed out some areas. Based on this paper, we found that this is well suited for smart homes, medical, and body control systems. It is hoped that this paper will benefit computer scientist who are keen to contribute their works to the field of automation.

.

## REFERENCES

[1] L. Louis, "Working principle of Arduino and using it as a tool for study and research," International Journal of Control, Automation, Communication and Systems, vol. 1, no. 2, pp. 21-29, 2016.

[2] L. Buechley, M. Eisenberg, J. Catchen, and A. Crockett, "The LilyPad Arduino: Using computational textiles to investigate engagement, aesthetics, and diversity in computer science education," Proceedings of the 2008 Conference on Human Factors in Computing Systems, CHI 2008, pp.423-432, 2008.

[3] B. Mallick and A. K. Patro, "Heart Rate Monitoring System Using Finger Tip Through Arduino And Processing Software,", International Journal of Science, Engineering and Technology Research (IJSETR), vol. 5, no. 1, pp. 82-89, 2016.

[4] H. Rubio, E. Soriano,and R. Barber, "A Low-Cost Lab Monitoring System Based on Arduino Microcontroller and

**TABLE 1**

*SUMMARY OF ARDUINO APPLICATION AREAS*

| S. No | Area | Applications |
|---|---|---|
| 1. | Smart Homes | motion sensors, outlet control, temperature sensors, blower control, garage door control, air flow control, sprinkler control and bill of materials |
| 2. | Defense | Arduino-based Ultrasonic Radar System |
| 3. | Aero Space | Airplane Flap Model, Integration of RC Vehicles in a Robotic Arena |
| 4. | Automated Vehicle Control | control-system experimentation, strategies, and sensors |
| 6. | Traffic Signal Control | Traffic Light Controller system |
| 7. | Medical | Cancer Detection, Heart Beat Rate measurement, Open source EEG/ECG/EMG, Breathalyzer, Thermometer, WI-Fi Body Scale with Arduino Board, Lilypad Slipper Automatic Foot Massager |
| 8. | Data Mining | Health care, industries, defense and other automation sectors |
| 9. | Laboratory | Digital microscope with automated slide movement, EEG/ECG, Sample collectors |
| 10 | Body Control | HandSight, Heart Rate Monitor, Muscle activity, Temperature, Respiration, Electrodermal Activity, Facial Expression, Eye Tracking |

Statements that serve as captions for the entire table do not need footnote letters.

Android," Proceedings of ICERI2015 Conference, pp. 8014- 8022, 2015.

[5] N. David, A. Chima, A. Ugochukwu, and E. Obinna, "Design of a Home Automation System Using Arduino," International Journal of Scientific & Engineering Research, vol. 6, no. 6, pp. 795-801, 2015.

[6] G. Bhor, P. Bhandari, R.l Ghodekar,and S. Deshmukh, "MINI RADAR," International Journal of Technical Research and Applications, vol. 39, pp. 68-71, 2016.

[7] M. M. Abdulkareem , Q. A. Mohammed and M. M. Shakir, "A Short Range Radar System : Rangefinder," Technical Report TR-EEE351, Electrical and Electronics Department, University of Turkish Aeronautical Association Electric and Electronic Engineering Department, 2016.

[8] P.S. Teja,, V. M. Krishna, and D.C. . Raja, "Industry Supervising System By Using Arduino & IOT," International Journal of Advanced Research in Electronics and Communication Engineering , vol. 6, no. 3, pp. 93-95, 2017.

[9] B.R. Swetha. D., Yuvasri., M. Karthiga, and S. Padma, "Density Based Traffic Control System Using Arduino Uno,",SSRG International Journal of Industrial Engineering, pp. 5-7, 2017.

[10] R. Rákay , M. Višňovský, A. Galajdová, and D. Šimšík, "Testing Properties of E-health System Based on Arduino," Journal of Automation and Control, vol. 3, no. 3, pp. 122-126, 2015.

[11] http://www.thingiverse.com/thing:38133 [Accessed 14 Aug 2019].

[12] http://www.youtube.com/watch?v=5soUDaIxXcY [Accessed 14 Sep 2019].

[13] http://en.wikipedia.org/wiki/Plethysmograph [Accessed 24 Sep 2019].

[14] http://www.electrodestore.com/EMG/EMG.lasso?ran=13151B
06&S=6&T=oops [Accessed 4 Oct 2019].

[15] http://www.sparkfun.com/commerce/product_info.php?pro
ducts_id=245 [[Accessed 15 Oct 2019].

[16] B.K. Venugopal and D. D'souza, "Real Time Implementation
of Eye Tracking System Using Arduino Uno Based Hardware
Interface," International Journal of Engineering and
Techniques, vol. 2, no. 6, pp. 140-147, 2016.

[17] P. Ingalepatil,, P. Barhate, B. Nemade, and V. D. Chaudhari,
"Alcohol Detection System in Vehicle Using Arduino,"
International Research Journal of Engineering and
Technology, vol. 4, no. 6, pp. 287-291, 2017.

[18] N.G. P. Martins, "Integration of RC Vehicles in a Robotic
Arena," Master's dissertation, School of Engineering &
Technology, Tecnico Lisboa, Portugal, 2016.

[19] E.C. Alvarez,, J. Holguino, and B. Restrepo, "Applying
Classical Control Theory to an Airplane Flap Model on Real
Physical Hardware," Proceedings of the 13th Latin American
and Caribbean Conference for Engineering and Technology,
2015.

[20] I. Kouris and D. Koutsouris, "Application of Data Mining
Techniques to Efficiently Monitor Chronic Diseases Using
Wireless Body Area Networks and Smartphones," Universal
Journal of Biomedical Engineering, vol. 1, no. 2, pp. 23-31,
2013.

[21] S. P Singh and S. C. Sharma, "A survey on research issues in
wireless sensor networks," Open Transmission in Wireless
Sensor Networks,, vol. 2, no. 1 , pp. 1–18, 2015.