Smart Electronic Systems on Human Assistance – A Review

S. P. Meena

Associate Professor, Department: H&S (Physics), Sri Indu College of Engineering and Technology, Hyderabad, India

E-mail: meena.palanisamy@gmail.com

Abstract

Electronic devices are micro programmed unit that are primarily designed for operate like a control unit on several applications. It is also implemented for doing several data and information processing purposes. The smart electronic devices are structured with a goal to make a connection between one or more devices. In recent years the smart electronic devices are designed to operate based on the command given by a human through voice or signals. In very rare applications the smart electronic devices are programmed to take decision on its own. The purpose of this article is to project the recent advancements in the smart electronic devices on healthcare, communication, automation, robotics and security applications. The article is also further extended to present the recent research growth in the field of smart electronics with its future directions.

Keywords: Smart sensor, wireless communication, intelligent systems, control devices, data transmission, device to device communication

1. Introduction

The devices that are used to control the operation of any circuit by alternating the flow of electrons are called electronic devices. It is attained by grouping several devices like transistors, resistors, diodes, microcontrollers etc. In recent years the electronic devices and gadgets have become a part of every human's life. The advancement in the microchip modules are reducing the sizes of the electronic gadgets into very minimal size and the incorporation of battery unit with the electronic devices make the system to be operate on the move [1]. Basically the electronic devices can be classified as follows in four major categories.

- Non-programmable device
- Programmable device
- Programmable device with data communication
- Smart device with internet connectivity

The lighting circuit is an example of non-programmable electronic device that allows the light to be operated on desired situations by controlling its operation with a mechanical or digital switch. The switch controls the flow of electrons over the circuit and that makes the light to be operated on required conditions. In general the programmable device are operated with a microcontroller unit that acts like a momentary switch to control the operation of a light or any other unit based on the program included to the microcontroller. The programmable devices with data communication are generally connected with a wiring unit to transfer the signals received from on electronic device to another device for its operation. The smart electronic devices are equipped with the internet communication that makes the system to be connected with other system located in so far distance through wireless medium [2-4]. Figure 1 explores the major areas where the electronic devices are applied so far.
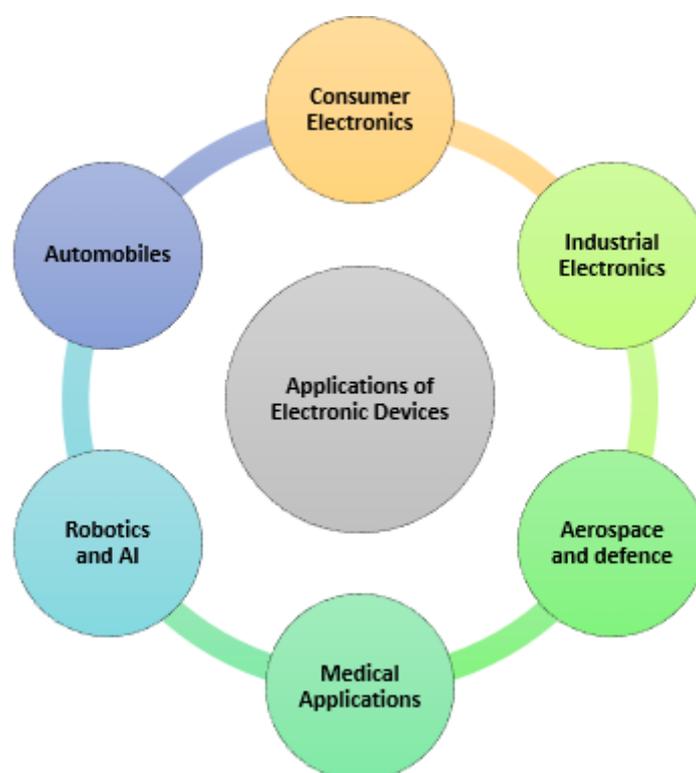

Figure 1. Applications of Electronic Devices

The consumer electronic devices are the systems that are used in the day to day life of a human. Such devices are widely employed to control the mechanical and electrical systems

through control switches. The control signals are programmed with the microchips and controllers. The large and advanced consumer devices are equipped with a dedicated memory unit for storing the analyzed data for further analyzing processes. The industrial electronic devices are formatted to control operation of major systems through automated programs built with sensor and other peripheral connections. The radar, unmanned aircraft modules, rocket and missile launcher are the heavy electronic systems that are implemented for defence and aerospace kind of applications. The electronic devices are also equipped in medical applications for recording and process several medical signals. It is also used for securing the information of the patient and other sensitive data through blockchain kind of modules. The image processing kind of systems are structured with multiple peripheral units for diagnosing various diseases. Traction control, anti-locking braking system and anti-collision unit are the examples of certain control modules that are implemented in recent years on the automotive industry. The development of neural network architectures allows the electronic systems to take decisions on its own and that results in the development of robotic applications. Figure 2 represents the architecture of a smart electronic device.
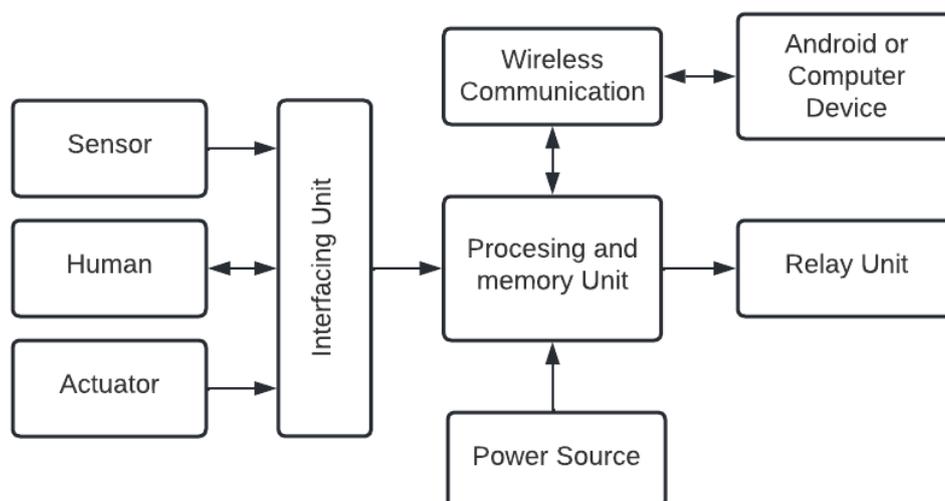

Figure 2. Architecture of smart electronic device

The smart electronic devices are structured with more than one input interfacing module and it makes the processing unit to take several decisions on its outcome. The outcomes are delivered to the hardware units through relay circuit and to the software units it is delivered with wireless communication in many cases. The processing unit in the advanced smart devices are programmed with neural network architecture to make self-decisions [5, 6]. The following section explores the attainments of smart electronic devices on human assistance applications.

2. Literature Review

Healthcare, communication, automation, robotics and security are the list of major application where the smart devices are assisting the humans. The below tables are exploring the attainments of the recent smart electronic devices on each human assisting applications.

Table 1. Study on smart devices in healthcare applications

Reference	Application	Approach	Outcome	Attainments
[7]	Sensor data analysis	Federated learning-based person movement identification	Data classification	Accuracy = 99.67%
[8]	Remote patient monitoring	Hyperspace analogue to context	Android based data sharing system	Secured medical data communication
[9]	Speech recognition system	Hybrid SVM with dynamic time warping	Assisting old people to control consumer devices	Accuracy = 97%
[10]	Patient monitoring system	Arduino based android application	Information transmission between ambulance and patient	One click location sharing system on emergency
[11]	Brain tumour segmentation	Biophysics-guided prognostic model	Disease stage prediction	Accuracy = 73%
[12]	Liver tumour segmentation	Modified ResUNet architecture	CT scan analysis	Liver segmentation accuracy = 99.71% Tumour segmentation accuracy= 99.72%

Table 2. Study on smart devices in communication applications

Reference	Methodology	Approach	Outcome	Attainments
[13]	Wearable sensor control	Dynamic and interoperable communication framework	Operation time control of the wearable devices	Better interoperability
[14]	Internet of medical things	Medical data interoperability through collaboration of healthcare devices	Reduces uplink traffic	Response time = 1.1 second
[15]	Task	Machine learning	Improved	Energy = 32 J for 1L

	scheduling in edge devices	algorithm	computational capability	samples
[16]	Home security system	Android application with Raspberry Pi	Suspicious activity alert system	Instant communication
[17]	Secure data transmission	Graphical clustering technique	Enhanced data transmission	Reduced data latency
[18]	Weather monitoring system	IoT based data logger	Multi-parameter monitoring	Provides continuous observation

Table 3. Study on smart devices in automation applications

Reference	Methodology	Approach	Outcome	Attainments
[19]	Home automation	Mobile Bluetooth communication	Controlling home appliances	Instant operation
[20]	Building automation system	Building automation and control networks	Building information modelling	Data export and import between the connected tools
[21]	HVAC system modelling	Performance degradation detector	Real-time energy monitoring	Makes alert signal on excess usage of energy
[22]	Defect detection system	Machine learning based acoustic defect detection	Reduced defect detection time as 2.061 seconds	F-measure = 98.48%
[23]	Human resource process automation	Robotic process automation	Performance management and analysis	Reducing error rate on estimations
[24]	EV charging system	Inductive magnetic resonance	Wireless charging system	Coil height enhancement = 39.5%

Table 4. Study on smart devices in robotics applications

Reference	Methodology	Approach	Outcome	Attainments
[25]	Image recognition	Electronic pollen information network	Reduces delay on recognition	Accuracy = 90%
[26]	Computer vision system	Otsu threshold algorithm	Fruit picking	Accuracy = 95%
[27]	Robotic navigation	SpineAssist and renaissance, Mazor robotics	Spine surgery	Accurate pedicle screw placement

[28]	Human action recognition	Mobile robot platform	15 frames / second operation	Accuracy = 70%
[29]	Target recognition	Local contrast enhancement with regression tree algorithm	Harvesting robot	Accuracy = 83.6%
[30]	Human posture recognition	Hybrid fuzzy logic with SVM	Depth and RGB image analysis	Accuracy = 97.1%

Table 5. Study on smart devices in security applications

Reference	Methodology	Approach	Outcome	Attainments
[31]	Securing healthcare data	Blockchain	Securing from attacks	Reduces computational complexity
[32]	Healthcare privacy preserving	Federal learning	Making reliable communication	Improves continuous transmission
[33]	Image security	Lightweight encryption technique	Minimizes security execution time	Encryption speed = 0.1MB/s
[34]	Electronic device authentication	Distributed ledger framework	Original component manufacturer verification	Counterfeit and classification of ICs
[35]	Big data analysis	DBSCAN clustering algorithm	Network information security system	70% of improvement in efficiency
[36]	Defense strategy on cyber attack	Linear matrix inequality	Power system security	Better load demand balance ratio

3. Discussion

The literature study indicates the growth of smart electronic systems in various fields. However, the healthcare system needs more attention towards the accuracy of the devices on its operation. There was lot of works made so far to minimize the sizes of the electronic devices with better operational efficiency but still the systems are in need of efficient computational algorithm. Similarly the growth of wireless sensor networks and internet of thing systems are allowing the sensors to transmit the signals from one place to another place with reduced delay time. Though the wireless communication systems are affected still with higher drop rate on the data transmission. Therefore such systems are devised with larger

transmission power that requires more energy for its operation. The research are still going on to make an efficient communication system that requires lower energy consumption. The automation applications attained a major growth in recent year due to the improvement of wireless data transmission that allows to design the automation system with a better cost. The wireless automation systems are failed at the time of network intrusions between its layers. Similar to automation system, the robotics system were also attained a better improvement on navigation, recognition and detection applications. The automation and robotic systems are degraded to its performance when it is affected with its instant response delay due to the computational complexity. Hence the research for making a light-weight algorithm on process automation is still in the lime light of the researchers. As the data and signal transmission are moving towards the wireless communication, the security towards such data has become questionable. Therefore several encryption based technologies were developed in the past years and the recent research moved it towards the direction of blockchain based technologies.

4. Conclusion

The electronic devices were invented to assist the humans on their daily needs. The performance of such electronic devices were quite good still it was connected with a wired circuit. There was plenty of researches were done to reduce the sizes of such electronic devices and that allowed such systems to be incorporated with multiple peripheral units. The work projects the concept and its attainments on various human assisted systems and it found still there is a need for a secured and better operational algorithm on smart devices. Similarly the drop rate plays a major role at the time of data transmission through wireless communication. The delay in data arrival makes the automated system to make irregular decisions on critical condition and it reduces the reliability of the smart electronic systems. The work suggests the smart electronic systems are need to be built with a light-weight processing algorithm along with a secured and efficient way of data communication modules.

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