

Implementation of Smart Control of Wheelchair for a Disabled Person



N. Prakash, E. Udayakumar, and N. Kumareshan

1 Introduction

An embedded framework is intended to perform devoted capacity. For a complete gadget, a mix of equipment and programming plays out an installed piece. Since an embedded framework has a constrained scope of utilizations, plan engineers face no issue to streamline both size and cost or improve unwavering quality and nature of execution. Inserted systems are compelled by any event of one guideline planning focuses regularly either by microcontrollers or by digital signal processors (DSP). A specific assignment [1] which require shocking processors is being committed with the key attributes, regardless. For instance, flight authority structures may steadily be seen as installed, paying little heed to the way that they join united worker PCs and submitted provincial and public systems among air terminals and radar areas (every radar surely combines in any occasion one inserted game plan of its own).

Since the comfortable framework is being submitted with express undertaking plan, the specialists can revive it to lessen the size and cost of the thing and augmentation and the suffering quality of execution. Some presented frameworks are mass made, profiting by economies of scale. Truly, installed structure goes from valuable contraptions, for example, activated watches and MP3 players, to gigantic fixed establishments like traffic signals, managing plant controllers, or the frameworks controlling atomic force plants. Multifaceted nature changes from low, with a

N. Prakash (✉) · E. Udayakumar
Department of ECE, KIT-Kalaignarkaranidhi Institute of Technology,
Coimbatore, Tamilnadu, India

N. Kumareshan
Department of ECE, Sri Shakthi Institute of Engineering and Technology,
Coimbatore, Tamilnadu, India

© The Author(s), under exclusive license to Springer Nature
Switzerland AG 2022

S. Nandan Mohanty et al. (eds.), *Internet of Things and Its Applications*,
EAI/Springer Innovations in Communication and Computing,
https://doi.org/10.1007/978-3-030-77528-5_7

solitary microcontroller chip, to astoundingly high with different units, peripherals and structures mounted a colossal case or fenced in area [2].

With an immense augmentation in the measure of more arranged individuals and the individuals with certifiable troubles are the gigantic applications for the course help of clever wheelchairs. Because of debacles, oldness, or issues as cerebral loss of movement plus, spinal string wounds, the level of debilitated individuals is climbing and now tending to 1 billion people, which address 15% of the general individuals.

As per the Tunisian assessment concentrate from the Ministry of Social Affairs of Tunisia 2013 spread in an online source and the furthermore excess of 208,465 Tunisians experience the detestable effects of assortment insufficiencies, where they address 2% of the whole populace. They happen under various focuses like ataxia, spasticity and engine brokenness, which cause a nonattendance of muscle coordination required unforeseen developments of postponement in appearing at engine aptitudes, shaking, shiver, and the failure to control the upgrades particularly exact ones like piece. They will undeniably cause a nonattendance of free movability, conviction, and security that require the utilization of adaptable hardware, for example a manual wheelchair and an electric wheelchair or the assistance of a guard to do their bit-by-bit life works out. Individuals are notwithstanding those different moving challenges happen with them and experiencing the furthest point failure [3].

2 Related Work

This alignment framework depends on a man-made brainpower technique. In this manner, a neural organization calculation is at that point applied; it is at present utilized for both exploration and creation by various groups in numerous applications in medication, designing, etc. With an expansion of old and impaired individuals, driving a wheelchair in homegrown conditions is a troublesome assignment in any event, for an ordinary individual and furthermore turns out to be considerably more hard for individuals with arms or hands disabilities. When an individual turns out to be genuinely crippled, then he/she faces a great deal of issue while moving from one spot to another. They use wheel seat. Beforehand, wheel seats were controlled manually. For that sort of wheel seats, the individual should be sufficient to control that; in any case, someone else should be there to screen the development of the seat [4]. A few patients who cannot control the heading of the wheelchair with their arms because of an absence of power face serious issues, for example, direction, versatility, and so forth. Thus, this wheelchair is created to conquer the above issues permitting the end client to simply perform safe developments and achieve some everyday life significant errands.

Taking all in this in thought we have chosen to do a touchscreen and furthermore joystick worked wheelchair. As contact screen innovation is securing most elevated top in different logical just as financially creating items, its utilization in patient cordial gadgets like wheelchairs may bring about improved nature of

administration. Contact screen innovation is the direct control type signal-based innovation. Joysticks were utilized in numerous applications like PC games, clinical gadgets, wheelchairs, mechanical technology, airplane, progressed vehicles, and different gadgets. Different instances of position detecting gadgets incorporate trackballs and computer-generated reality hardware, for example, protective caps, goggles, gloves, and foot pedals [5].

Joysticks were fundamentally a basic course of action of contact switches at four quadrants. Moving the joystick shaft away from its focused position shut one of the four switches, contingent upon the bearing of development [6]. At that point it is prepared through the regulator. Today, in market there are various wheelchairs available watching out anyway they are not inserted with sharp structures in the event that they are open, by then the expense is going from 3 lakhs to 4 lakhs, and this cost is not reasonable for a normal person [7]. With the revived movement of developing of the general population being represented in numerous post-present day countries, interest in Cartesian mechanical innovation, on which most customary approaches to manage canny progressed mechanics are based, followed by making game plans for the time of development progression and work step by step in complex genuine conditions with extended execution in productivity, security, and flexibility, and exceptionally diminished computational necessities.

The cerebrum wave starting late has gotten a subject of interest for controlling machines. To do thusly, electroencephalography (EEG) signal models should be described and accumulated into the proposed exercises. The customer ought to have incredible enthusiastic control and center for amazing control. This is a weight to the client despite the fact that this medium might be a decent other option for individuals with a completely incapacitated body. Looking input offers great data, for example head and eyes are the headings of control [8]. The fundamental thought is that a zone at which the client looks speaks to the expected bearing, which impersonates human physiological conduct during strolling or driving. While this medium appears to be a decent applicant, it is difficult to recognize between activities for guiding the wheelchair or essentially glancing around. Along these lines, the clients need to avoid seeing environmental factors and to focus on route during driving. Maybe the best answer for construing contribution from the client with extreme engine incapacities is depending on multi-client input approaches, so that various conceivable client's signals are examined prior to giving the ideal order. Utilizing this technique, we can relegate each controlling errand into the diverse client's info and henceforth will force less weight to the client contrasted with the case that exclusively depends on a solitary information [9].

While option in contrast to joystick mediums empowers the objective patient to move, the route trouble is still absolutely on the client. As indicated by among 200 rehearsing clinicians in the USA, 40% of their patients think that it is hard or difficult to control the wheelchair despite having such elective mediums [10]. Most as of late, it has likewise been accounted for in that most patients with engine hindrance can't direct the wheelchair for keeping away from deterrents and equal stopping. These clinical discoveries give knowledge to the significance for contriving a PC controlled stage to help the clients by decreasing their outstanding burden and

expanding the well-being. In this structure, the client contribution alongside the ecological data will be flawlessly dissected for performing fundamental assistive undertakings. The measure of given help generally shifts relying upon how serious the clients' hindrances are. It performs transient course arranging, and the clients possibly mediate it when they wish to digress from the arrangement [11]. This implies that when an order is given, the clients can unwind while the PC is finishing the undertaking. In contrast to the self-sufficient control, the semi-self-governing control need not bother with a real guide of the climate; just a nearby well-being map dependent on sensor filtering is required. Henceforth, it can offer opportunity to the clients to move in new conditions [12].

Handicap is a problem that hampers the day-by-day life of the influenced individuals by restricting the individual's development, detects, capacity to think or act. Handicap can either be intrinsic or gained. Innate inabilities are generally acquired, while gained incapacities happen because of any mishap or sickness. As per the report of the Australian National University, handicaps can be of various kinds, for example, vision hindrance. Engine handicap is the halfway or on the other hand all out misfortune in strong elements of the body. These incapacities incorporate joint inflammation, cerebral paralysis, various sclerosis, strong dystrophy, procured spinal injury (paraplegia or quadriplegia), post-polio condition, and spina bifida [13]. All of these inabilities restrain the ordinary development of the influenced individuals. Almost 15% of the total populace comprises individuals having inabilities, and 2–4% of them have significant issues in working. One of the most widely recognized guides for development for the genuinely impeded individuals is the wheelchair; it is as yet insufficient to address the issues of a wide range of engine incapacities. Wheelchairs are basically intended to help individuals experiencing incapacities in the lower appendage region. Accordingly like quake, individuals who have issues in the upper appendage territory cannot use the wheelchair appropriately. Along with this problem, it is practically difficult for consistency [14].

As of now in market, sharp wheelchairs are accessible at any rate and are not reasonable by typical people. They are controlled utilizing high-force battery by using super force engines, besides expands the expense of the thing is so tolerable. The seat accommodated with the advancement of such social requests require a part or an overseer with them [15]. Manual or standard wheelchair is a wheelchair that is generally utilized by a layman. An average individual cannot bear the cost of power wheelchair so they utilize the standard one.

3 System Design

PIC is a social affair of Harvard putting together microcontrollers made by Microchip Technology, got from the PIC1640. From the beginning Microelectronics division 1 is made by general instruments (Fig. 1)

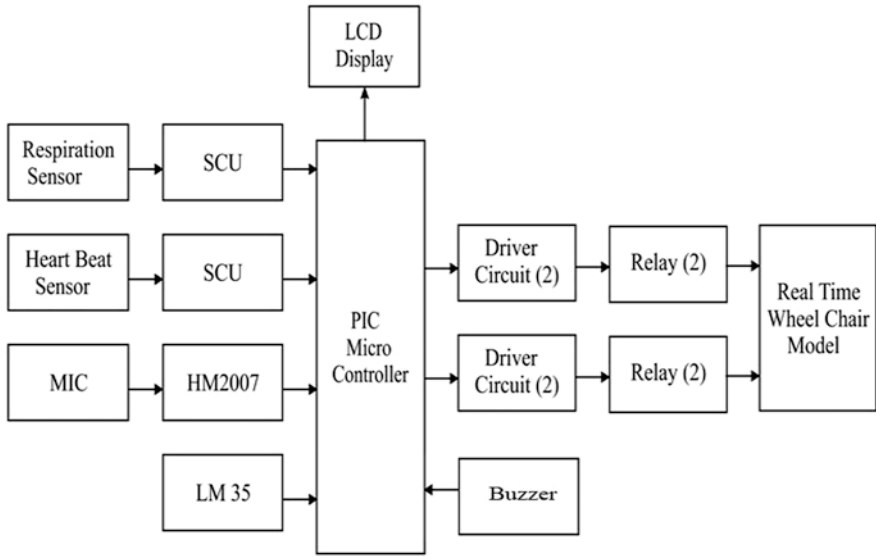


Fig. 1 Block diagram of the proposed system

(a) Stacks

PICs have an apparatus call stack, to bring address back were is utilized to spare. The ringing stack available on prior gadgets is not modifying, yet this changed with the 18 arrangement contraptions. Equipment support for an inside and out accommodating boundary stack was deficient in early blueprint; at any rate, the phenomenally improved in 18 game plan making the 18 approach structuring considerably, increasingly, and neighborly to the basic level language compilers [16].

(b) Instruction Set

A PIC’s headings change from around 35 standards for the PICs to more than 80 guidelines for first-in-class PICs. The bearing set reviews rules to play out an assortment of activities for registers, obviously the locator and a requesting reliable for finder finning [17]. A piece setting and testing, can be performed on any numbered register, regardless bi-operand math assignments constantly combine W (the force), making the result back to one or the other W or the other operand register. To stack a dependable very well, it might be moved into another register before it is fundamental to stack. On the more settled focuses, all register moves expected to experience W, yet this changed on the “most critical reason for the line” focuses.

(c) Relay Driver

A hand-off is an electro-attractive switch that is valuable on the off chance that you utilize a circuit to turn on and off a light (or whatever else) with the 220 V main source [18]. The graph beneath shows a run-of-the-mill hand-off (with “regularly open” contacts). The expected current is more than to work the hand-off curl,

provided by most chips (operation, amps, and so forth), so a transistor is typically required.

(d) **Buzzer**

Buzzer is a sound hailing device, which may be mechanical or piezoelectric. Average business of ringers consolidate is a ready devices, tickers and attestation of customer data for instance, a mouse snap or keystroke. An electric sign uses a similar instrument to an interrupter toll, anyway without the full ringer. They are more settled than ringers, yet adequate for a notification tone over a little division, for instance, over a work zone [19].

(e) **LCD**

Liquid crystal displays (LCDs) are utilized in for all intents and purposes indistinguishable cases where light emitting diode (LEDs) are utilized. These solicitations are show of numeric and alphanumeric text styles in spot position and segmental highlights.

(f) **Liquid Crystal Cell**

The fluid disturbs the atomic arrangement and produces choppiness. At the point when the fluid is not initiated, it is straightforward. At the point when the fluid is initiated, the sub-atomic disturbance makes light be dissipated every which way, and the cell has all the earmarks of being splendid. This wonder is called dynamic dispersing. A liquid crystal display (LCD) is an electronically changed optical contraption merged into a petite, level board. It is as often as possible utilized in battery-energized electronic devices since it uses outstandingly constrained amounts of electric power [20].

(g) **Heartbeat Measurement**

The beat rate is an estimation of the beat, or the events the heart pounds each second. As the heart pushes blood through the passageways, the courses broaden and contract with the movement of the blood. Taking a heartbeat checks the beat and can exhibit the furthermore going with. The regular heartbeat sound for adult ranges from 60 to 100 beats per minute. The beat rate may change the addiction with work out, harm and emotions. Females ages 12 and progressively prepared, when in doubt, will by and large have faster heartbeats than do folks. Contenders, for instance, runners, who do a lot of cardiovascular embellishment, may have heartbeats right around 40 thumps for every second and experience [21].

(h) **Respiration Measurement**

Ordinary respiratory rate might be characterized as an individual's respiratory rate while resting. This rate changes with numerous elements, specifically age, sex, or ailments like asthma, seizures, bronchitis, untimely birth, indigestion malady, and so on. The rate ought to be estimated when an individual is resting and his/her feelings of anxiety are least. The most ideal path is to tally the breaths when the individual does not know about it being estimated [22]. This rate has a pattern of

lowering down with age. Babies have a high typical respiratory rate, which lowers down as they develop.

Here's the age-wise range: The principle explanation behind the occurrence of age is ascend in limit of the lungs as an individual develops. Despite the fact that a grown-up breathes in less much of the time that a kid, the volume of air breathed in by a grown-up is ordinarily more than that breathed in by a kid [23]. This circuit is intended to quantify the breath. Right now thermistor is utilized for breath estimation, which is associated with the resistor connect arrange. The extension terminals are associated with modifying and non-transforming input terminals of the differential enhancer (Fig. 2).

The differential speaker is developed by the LM741 operational intensifier. Here, one thermistor is utilized for breath estimation. Another thermistor is utilized as reference, which gauges [22] the room temperature. The differential speaker gives the mistake voltage at its yield. At that point, the mistake voltage is sifted by the following phase of the operation amp. The yield voltage is changed over to +12 to -12 V square wave beat through the comparator. At that point, the square wave beat is changed over to 5 to 0 V TTL heartbeat through the transistor (BC 547). At that point, the last TTL beat is given to a microcontroller so as to screen the breath rate.

(i) Temperature Sensor

It is a precision-associated temperature sensor of centigrade circuits whose yield voltage is straightforwardly relative to the temperature of Celsius (centigrade). Accordingly, LM35 has a respectable circumstance over direct temperature sensors altered in Kelvin degree, as the client is not required to deduct a massive [24] consistent voltage from its thought to get incredible centigrade scaling. The sensor yield differs by 10 mV for every level of Celsius temperature rise.

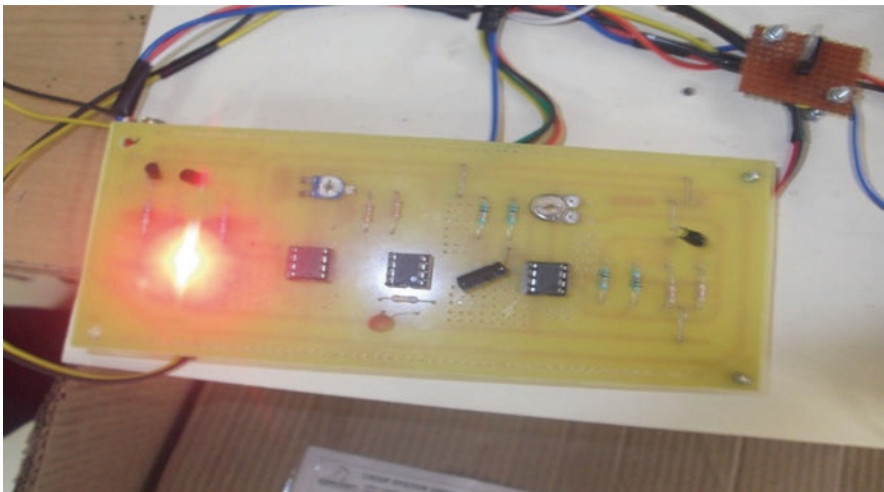


Fig. 2 Respiration measurement setup

(j) **Speech Recognition System**

The talk affirmation system is a completely accumulated and easy-to-use programmable talk affirmation circuit. Programmable, as in you train the words (or vocal enunciations) you need the circuit to see. This board grants you to investigate various roads in regard to various parts of talk affirmation development. It has eight piece data out which can be interfaced with any microcontroller for extra improvement. Some of interfacing applications that can be made are controlling home machines, applying self-governance advancements, speech-assisted developments, speech to content translation, and some more [25].

(k) **Homonyms**

Homonyms are words that sound the same. For example, the words feline, bat, sat, and fat sound the same. In light of their like sounding nature, they can befuddle the discourse acknowledgment circuit. When picking objective words for your framework, do not utilize homonyms.

(l) **Voice Security System**

This circuit is not intended for a voice security framework in a business application, yet that ought not keep anybody from trying different things with it for that reason. A typical methodology is to utilize three or four watchwords that must be spoken and perceived in grouping so as to open a bolt or permit section [26].

(m) **Aural Interfaces**

It has been discovered that blending visual and aural data is not compelling. Items that require visual affirmation of an aural direction horribly decrease effectiveness. To make a powerful AUI, items need to comprehend (perceive) directions given in an unstructured and proficient techniques. The manner by which individuals commonly convey verbally.

4 Results and Discussion

(a) **Heartbeat Output**

The heartbeat rate analyzed for 10 s is 04 the count is ($4 \times 6 = 24$); it is the abnormal heartbeat rate as shown in Fig. 3.

The heartbeat rate analyzed for 10 s is 15 the count is ($15 \times 6 = 90$); it is the normal heartbeat rate as shown in Fig. 4.

(b) **Respiratory Output**

The normal respiration rate for humans is between 12 and 20/min. Figure 5 shows the abnormal respiration rate as 30 counts/min. Figure 6 shows the normal respiration rate as 20 counts/min.



Fig. 3 Abnormal heart beat



Fig. 4 Normal heart beat rate



Fig. 5 Abnormal respiration rate as 30 count/min



Fig. 6 Normal respiration rate as 20 count/min

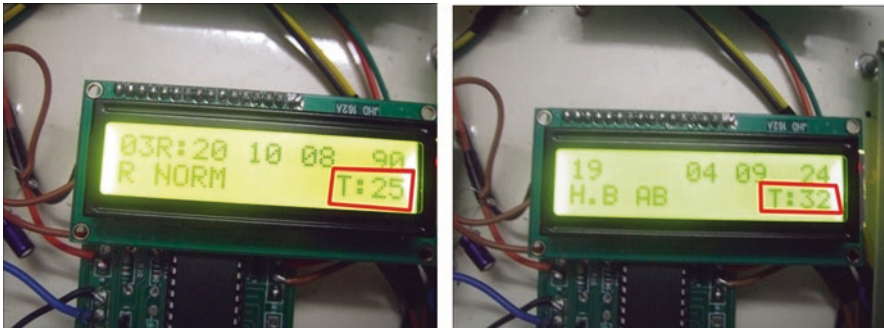


Fig. 7 Normal temperature rate of humans

(c) **Temperature Output**

The normal temperature rate for humans is between 35 and 40° C. Figure 7 shows the variations in temperatures.

(d) **HM2007 – Speech Recognition Output** (Figs. 8, 9, 10 and 11)

The locomotive control of the wheelchair is shown in Fig. 12.

(e) **Parameters in Wheelchair**

The voice-controlled wheelchair with heartbeat measurement, temperature measurement, and respiratory rate kit is shown in Fig. 13.



Fig. 8 Forward direction



Fig. 9 Reverse direction



Fig. 10 Right direction



Fig. 11 Left direction



Fig. 12 Stop

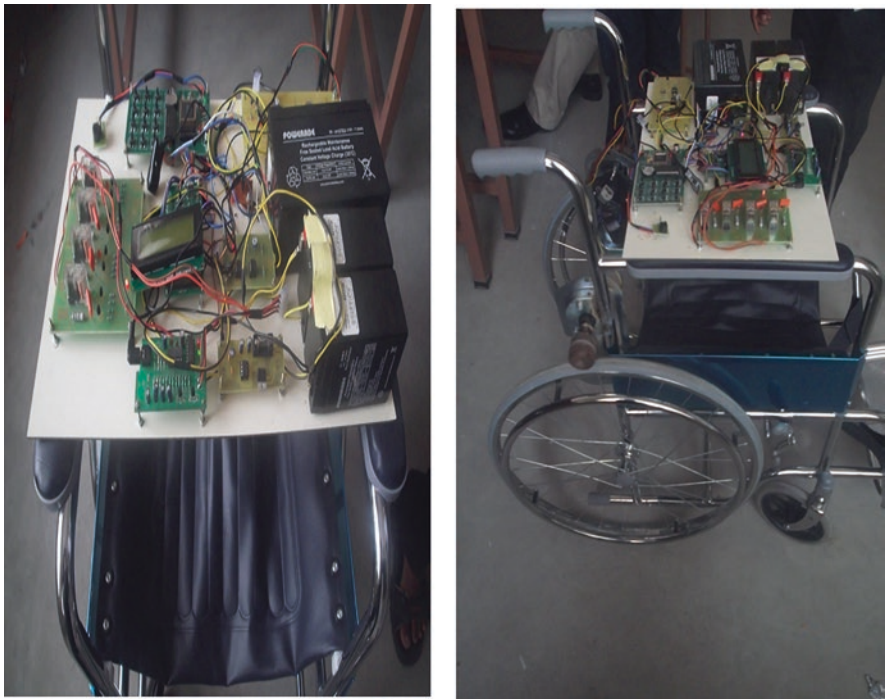


Fig. 13 Wheelchair with heartbeat measurement, temperature measurement, and respiratory rate kit

5 Conclusion

Quadriplegic persons are the main issue in the biomedical world. In which locomotive of their wheelchair by themselves is not possible. By using our paper, they can control their wheelchair through their voice. We have also implemented various physiological parameters for analyzing the heartbeat rate, respiratory rate, and temperature rate of a patient using the smart control wheelchair.

References

1. K. Stanton, P. R. Sherman, M. L. Rohwedder, C. P. Fleskes, D. R. Gray, D. T. Minh, C. Espinoza, D. Mayui, M. Ishaque, M. Perkowski, PSUBOT-a voice-controlled wheelchair for the handicapped. Proceedings of the 33rd Midwest Symposium on Circuits and Systems, vol. 2 (1990), pp. 669–672.
2. B. Arun Pradeep et al., Automatic battery replacement of robot. Adv. Nat. Appl. Sci. **9**(7), 33–38 (June 2015)
3. T. Kanagaraj et al., Foot pressure measurement by using ATMEGA 164 microcontroller. Adv. Nat. Appl. Sci. **10**(13), 224–228 (September 2016)
4. K. Srihari et al., An enhanced face and Iris recognition based new generation security system, in *Computing, Communications, and Cyber-Security*, Lecture Notes in Networks and Systems (LNNS) Series, vol. 121, issue 1 (Springer, Singapore, May 2020), pp. 845–855
5. T. Debnath, A.F.M. Abadin, M.A. Hossain, Android controlled smart wheelchair for disabilities. Global J. Comp. Sci. Technol.: G Interdisciplinary. **18**, 9–12 (2018)
6. Y. Rabhi et al., Intelligent control wheelchair using a new visual joystick. J. Healthc. Eng. **2018**(3), 1–20 (2018)
7. R. Subha et al., Coma patient health monitoring system using IOT. 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS), 2020
8. K. Srihari et al., Automatic battery replacement of robot. Adv. Nat. Appl. Sci. **9**(7), 33–38 (June 2015)
9. P. Vetrivelan et al., Design of smart surveillance security system based on wireless sensor network. Int. J. Res. Stud. Sci. Eng. Technol. **4**(5), 23–26 (August 2017)
10. N. Prakash et al, Arduino based traffic congestion control with automatic signal clearance for emergency vehicles and stolen vehicle detection. Proceedings of IEEE International Conference on Computing, Communication and Informatics (ICCCI-2020), Coimbatore, 2020, pp. 1–6
11. K. Srihari et al., Implementation of Alexa based intelligent voice response system for smart campus, in *Innovations in Electrical and Electronics Engineering*, Lecture Notes in Electrical Engineering (LNEE) Series, vol. 626, issue 1 (Springer, Singapore, March 2020), pp. 849–855
12. R.-X. Chen et al., System design consideration for digital wheelchair controller. IEEE Trans. Ind. Electron. **47**(4), 898–907 (2000)
13. S. Santhi et al., SoS emergency ad-hoc wireless network, in *Computational Intelligence and Sustainable Systems (CISS)*, EAI/Springer Innovations in Communications and Computing, (Springer, Cham, 2019), pp. 227–234
14. P. Vetrivelan et al., A NN based automatic crop monitoring based robot for agriculture, in *The IoT and the Next Revolutions Automating the World*, (IGI Global, Hershey, 2019), pp. 203–212
15. K. Srihari et al., A smart industrial pollution detection and monitoring using internet of things (IoT), in *Futuristic Trends in Network and Communication Technologies*, Communication in Computer and Information Science (CCIS) Series, vol. 1206, issue 1, (Springer, Singapore, April 2020), pp. 233–242

16. N. Prakash, E. Udayakumar, N. Kumareshan, R. Gowrishankar, GSM-based design and implementation of women safety device using internet of things, in *Intelligence in Big Data Technologies-Beyond the Hype*, Advances in Intelligent Systems and Computing, ed. by J. Peter, S. Fernandes, A. Alavi, vol. 1167, (Springer, Singapore, 2020)
17. H.R. Singh et al., Design & develop of voice/joystick operated microcontroller based intelligent motorised wheelchair. *IEEE Tencon* **2**, 1573–1576 (1999)
18. T. Kanagaraj et al., Control of home appliances and projector by smart application using SEAP protocol, in *Intelligence in Big Data Technologies-beyond the Hype*, Advances in Intelligent Systems and Computing (AISC) Series, vol. 1119, issue 1, (Springer, Singapore, March 2020), pp. 603–610
19. A.R. Trivedi et al., Design and implementation of a smart wheelchair. Proceedings of Conference on Advances in Robotics July 2013, pp. 1–6
20. K. Srihari et al., A smart industrial pollution detection and monitoring using internet of things (IoT), in *Futuristic Trends in Network and Communication Technologies*, Communication in Computer and Information Science (CCIS) Series, vol. 1206, issue 1 (Springer, Singapore, 2020), pp. 233–242
21. S. Tamilselvan et al., Development of artificial intelligence based assessment writing robot for disable people. International Conference on Smart Structures and Systems (ICSSS), India, pp. 1–6 (2020)
22. T. Dharanikaand et al., Intelligent wheel chair for disabled person. *Int. J. Innov. Res. Sci. Technol.* **3**(01), 257–261 (June 2016)
23. N. Prakashand et al., Design and development of android based plant disease detection using Arduino. 2020 International Conference on Smart Structures and Systems (ICSSS), Chennai, India, 2020, pp. 1–6
24. R.S. Sharma et al., Smart wheelchair for physically handicapped persons. *Int. Res. J. Eng. Technol.* **05**(05), 542–547 (May 2018)
25. T. Gomi, A. Griffith, Developing intelligent wheelchairs for the handicapped, in *Assistive Technology and Artificial Intelligence*, Lecture Notes in Computer Science, ed. by V. O. Mittal, H. A. Yanco, J. Aronis, R. Simpson, vol. 1458, (Springer, Berlin, Heidelberg, 1998)
26. M.R.M. Tomari et al., “Development of smart wheelchair system for a user with severe motor impairment”, international symposium on robotics and intelligent sensors 2012. *Procedia Eng.* **41**, 538–546 (2012)