IoT and Wireless Sensor Network based Surveillance Robot for Health Care Applications

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Abstract
Internet of things (IoT) is developing day by day and it is the future of computer technology and networking. This paper explains about the working, plan and implementation of IoT and wireless Sensor based surveillance robot using Arduino uno controlled by hand gesture. The main motto of the gesture recognition to reduce the human power to control robot to enhance and showcase their skills. The hand motion or gesture was recognized by using gyroscope accelerometer. There are so many ways and algorithms are there and implemented to recognize the hand gesture. Here we are dividing the robot into two circuits, transmitter and receiver. The Transmitter circuit contains Gyroscope and Accelerometer (MPU6050), Arduino UNO, Transceiver (NRF24L01). The Receiver circuit contains Motor Driver (L298D), Transceiver (NRF24L01), BLET (Bluetooth low energy tags), Arduino UNO. The motto of the project was according to the hand motions the robot must react. Hand motion detected by the gyroscope accelerometer. The Main Reason of the mixing the BLE Tags with Robot is to help the soldiers who are at the border of the country, so that at the time of war they can move their robots by their own wish so that they can know where the Land Mines are present and can see the robot status in mobile app.

Keywords— Arduino uno, Bluetooth low energy tags, Internet of Things, Mobile robot, NRF protocol, Wireless Sensor Network.

1. Introduction

Internet of things is used to connect the multiple devices using internet with artificial intelligence. Communication with the light, Bluetooth, radio frequency (RF) and sound are used to communication between devices without wires and it is making the Internet of Things a reality [1]. Here we are using Radio Frequency (RF) to transmit and receive the data. There are so many technologies to transmit the data using Radio Frequency (RF). They are nRF24l01, Wi-Fi (Wireless Fidelity), Zigbee and LoRa (Long Range) [2]. In this paper we used nRF24l01 module. The nRF24l01 module is wireless transceiver module and it is used to send the data and receive the data [3]. This module is same for transmitter and receiver. They work on the frequency of 2.4GHz – 2.5 GHz RF and it comes under the communication protocol of ISM band this band is used wherever you want in the world it is legal [4]. The range of the module was 50 – 200 feet at the baud rate of 2 MB/s and its operating voltage is 3.3V. The channel range is up to 125 and each module every device communicates with 6 other devices at a time [5]. The hardware was developed by OSI model. The cost of the

module was low comparing to other models. In Arduino uno ide there is pre-defined library for nRF24l01, and it is very easy to control using some lines of code [6]. So that for controlling nRF24l01, in this project we used Arduino uno. Arduino ide is an open source software. It is very easy to use and it was controlled by simple programming which everyone can understand. It is looks like basic c language every small programmer also handle it [7]. The hardware connection of Arduino uno is very easy so we prefer Arduino for this project. The operating voltage of Arduino is 5 Volts and input voltage is 7 to 20 Volts. Arduino uno consists of 14 digital I/O pins includes 6 pins for PWM output and 6 pins for analog input. Size of flash memory for Arduino uno is 32 KB [8]. For gesture recognition we used MPU6050 (Gyroscope accelerometer). It consists of 3 -axis accelerometer and 3 – axis gyroscope. Mpu6050 is used instead of joystick, remote controller etc. MPU6050 operation voltage is +3 to +5 Volts. It works on I2C protocol [9]. It was mainly used in drones, self-balancing robot etc. For motors control we used L298N motor driver [10]. By using this we can control 2 motors. The main motto of using this motor driver is Arduino uno does not give more than 5 Volts output voltage so, for external power supply to motors we use this motor driver [11]. The operating voltage of L298N is Max 46 Volts and logic voltage is 5 Volts. And it is also consisting of heat sink [12]. For detecting the location of the robot, we used BLET (Bluetooth low energy tags). The main motto of the project was the robot should be controlled by hand motion of controller and the robot should send location of robot and video of surrounding to controller by using camera and Bluetooth low energy tags [13]. By using all of this we control robot wherever you want within certain range. For another method of dealing with the Attendance Monitoring and Access Control framework BLE TAG is the safe framework for: getting to a zone [14], recording participation with identification and opening a passageway from up to 10 meters away sans hands. With BLE TAG we can achieve greater security by wiping out duplication danger of identifications. Simplification of badging in open air conditions (for example building destinations) [15]. Check your representatives' area in case of need. The BLE reader that we have created has a TTL sequential interface and can be coordinated (likewise inside) with all the gadgets in our range that have a port for the TTL reader. Also using BLE TAG we can have access control and attendance monitoring one can consequently enrol the participation, can open any door, likewise a way off and sans hands. For Safety You can check those present in a given region. And Now, we are coming the use of BLE (Bluetooth low energy) tags in this paper [16]. these Bluetooth low energy tag is used as the sensing of the objects. it can be used as sensing many other objects, but in our paper, we are using it to sense the robot movement's [17]. By replacing the RFID tags, we are using this BLE because of its lasting years of with small battery, very cheap (when compared to RFID), it actively presents the advertisements to its nearby readers/viewers [18]. And the most important thing is these days all the mobile network company provides the support of the Bluetooth low energy, which is already brought out to the market few ages ago. The motive of the outer cell phone network providers is to identify the nearness of the electronic gadget of the groups who are using it [19]. Now-a-days in the current situation people are almost missing their wallets, purses, boxes, keys in the outdoor and indoor location. By overcoming this problem if we keep the Bluetooth low energy tag on the particular thing or place in it, we can easily get the location of the tag [20]. By this way we can always find the lost item or we can access the exact location of it. So, in this way the Bluetooth low energy tag helps us to find the accurate location of it [21]. As we know, we are the first to use this Bluetooth low energy tag labels for the swarm investigation under the arrangement. we open up the occasional tag of the Bluetooth low energy electronic device, which could be shown out by the near electronic devices [22]. And we can also listen the ads that are inbuilt messages in these Bluetooth low energy tag. we built a support system to store the information regarding the uses of Bluetooth low energy tags. Which are included of mobile

app and web-server. Several machine learning-based methods in this contest are presented in [23]-[26].

2. Methodology

Figure. 1 shows the detailed architecture and working of robot. From above figure a Gyroscope accelerometer (MPU6050) sensor for direction control, Bluetooth low energy (Bluetooth low energy tags) module for detecting location and motor driver (L298N) for control the motors. This system works by human interference because robot was controlled by our hand motions only. nRF24l01 is used to send the gyroscope accelerometer data and ultrasonic sensor data. First gyroscope accelerometer (MPU6050) sensor senses the motion of the hand according to the x, y and z axis and it sends to the microcontroller (Arduino uno). Gyroscope accelerometer senses the slight change in your hand motion and its send data in digital like (1, 2... up to 20000). Due to this large numbers we encode this 20000 to (100 to 200). This one done by the Arduino programming. Gyroscope accelerometer consist of 3 – axis compass which is calculated the motion change of sensor. In Arduino uno there is special library for mpu6050 due to this interfacing of Arduino uno to mpu6050 and programming makes easier. Arduino uno encode the digital data which was coming from the gyroscope accelerometer however we want. After encoding the data, the microcontroller passes the data to NRF24L01 (Transmitter and receiver). The motto of the NRF24L01 is send the encoded data of gyroscope to receiver. The receiver receives the data and send to the Arduino uno at receiver end. The Arduino uno receives the data from the receiver, and it was sent to motor driver however we want. The motor driver controls the motors according to the micro controller data. We used the Bluetooth low energy tags to detect the location of robot and send the data to mobile app. Gyroscope accelerometer is essentially a sensor for movement handling robots. It has initial six measurement movements GPS beacon. It was intended for ease and superior exhibitions cell phones etc. It is equipped for preparing 9 pivot calculations, it catches movement in X, Y and Z hub simultaneously. MPU6050 is utilized in various modern activities and electronic gadgets to operate and distinguish the 3-Dimentional movement of various articles. Here we used ultrasonic sensor because when the robot is in automatic driving mode the robot should not collide to another object, so we used ultrasonic sensor. The robot is essentially electro-mechanical machine or gadget that is controlled either by PC program or with electronic circuit to perform assortment of physical undertakings. With the progressive advancement in innovation researchers think of novel thoughts and creations of robots. In the present life robot are turning out to be basic piece of human life. The mechanical innovation likewise gives robot in clinic, office and industrial facility. Other than computerization this innovation additionally utilized in Defence powers, Entertainment, Space investigation, Security frameworks and numerous perilous mission execution. For avoiding security problems and for safety for human life robots are used for avoiding opponents in India defence. Robots are used in nations like India for avoiding argumentative issues. Automated robot machines are used in states like Mumbai and Kashmir to avoid fighting issues and to safe life of human by using ultrasonic sensor senses the near object sending some ultrasonic waves with emitter. If the wave touches the any object, the ultrasonic waves reflects and sense by detector and sends acknowledgement to Arduino. Now ultrasonic sensor looks for another direction which has no obstacles to move free. For video recording we used ESP32 camera module which works with Wi-Fi. We must connect to the wi-fi to transmit the video to controller. After connecting to Wi-Fi, the module provides some secured link to view the video. The main use of this robot is finding landmines. Due to this robot there is no human loss because we add landmine sensor to this robot means without going to landmine site by sending robot we can find. And it is very easy to use. In future we can develop with machine learning and artificial intelligence. By using these technologies

humans are not required to control the robot. The robot will take their own decisions according to program. If we use artificial intelligence and machine learning, we have to use raspberry pi instead of Arduino because it is very easy to use and updated technology the Arduino uno. By using the hand motion, we can do so many things easier. The main pro Bluetooth Low Energy in this project was distance because nRF24L01 can only serves their operation between 50-200 meters. So, we can use cloud computing and some other IOT devices we can change the operating distance. We Decided to do an operation of detecting engineering to uphold the assortment of the provided details of a Bluetooth low energy Tags, Mobile app's furthermore, a web-active-server. Bluetooth Low Energy tag detects essential a huge native stealing generally modest away Bluetooth Low Energy nearness labels moreover few members to start filtering application on their electronic Devices [27]. We started do out an enormous exploratory work with 2 tags that are put inside the robot and 10 cell phones directed during the testing of robots [6]. Bluetooth low energy tags operate by conveying commercial information in the 3 assigned ad stations, to be found by a cell phone Bluetooth low energy tags scanner inside publicized inclusion scope of 50-100 meters. Besides, Bluetooth low energy tags underpins an association stage that sets up a relationship between the particularly recognizable Bluetooth Low Energy tag and a physical thing. We led a restricted arrangement of examinations for utilizing the intensity of Bluetooth low energy tags label notices in a high-thickness setting. These investigations aid us to build up a Bluetooth low energy tags printer application with boundaries appropriate for very high perceptibility in existence of huge count of Bluetooth low energy labels. The primary test was to check the scope of Bluetooth low energy labels in open air position. We set Figure2. Bluetooth low energy tags open air extend testing. the signal to communicate at 100ms with 4dB force. We tried position at 10-meter intervals beginning from 10 meters up to 80 meters. At each position we found the logged the RSSI furthermore, packet quantity got without blunder. Figure. 2 is visible as the consequence of this analysis part. The outcome shows that packet was gotten at separations past 50 meters which checks the practicality of the examination. The subsequent test was to set the reasonable Bluetooth Low Energy filtering boundaries required for our investigation. We have to set the output span sufficiently huge to catch enough parcels from the labels, yet we have to ensure the output span is little enough not to devour the telephone's vitality. During our lab assessment, we had the option to distinguish 10 one of a kind label ad effectively in a 30 seconds filter cycle, where labels were communicating notice signals each 5 seconds. The more drawn out output term assisted with finding labels whose parcels were lost because of crashes. The 30 seconds check cycle was rehashed at regular intervals, considering the anticipated robot versatility and adequate logging for identification occasions. The robot development detecting test was performed mostly to comprehend the perceptibility proportion and the exactness in location by recreating the member's courses. Planning a engaged framework is a non-trifling errand as it faces a lot of figuring and moreover configuration challenges. The application needs impressive plan exertion to oversee information assortment for implanted electric-sensors, working on foundation, as well as dealing with the information unloading. In contrast to other versatile stages, the Android stage is advantageous for this type of help. Accordingly, the versatile application was just focused for the Android stage. In swarm detecting applications where persistent programmed information assortment is wanted, the application ought to be planned in a way where it could run out of sight and keep on playing out its tasks in any event, when the gadget is in backup or rest mode. These tags are very low cost. For our application, such basic highlights were needed to anticipate least client association to perform information assortment:

1) By removing old bugs and added the new features, so that the mobile begins itself.

2) Unstoppable information assortment on customary spans regardless of the gadget state for example dynamic or backup

3) Auto transfer gathered information on customary spans to the predefined worker

4) Decrease assortment rate on less battery sign

5) End information assortment when the battery state is fundamentally less than the required.

Furthermore, re-establish assortment cycle when the battery is adequately charged. And the way of functioning of the robot with the Bluetooth low energy tags is, the tag is placed in the robot which means that the navigation [28] of robot which goes according to the man who is moving his hand, the way and the route is clearly seen in the mobile app of Bluetooth low energy tag which is available Bluetooth Low Energy in Play Store. We can either download or develop our own application which is earlier mentioned above.

3. Results and Discussion

The motto of this paper is to achieve the hand motions of the robot must react. Hand motion detected by the gyroscope accelerometer. BLET is used to detect the location of the robot. Bots are also added with an UT electric sensor for avoiding blocks during way. identifying the robots to comprehend robot parts will be a difficult assignment. Latent identifying procedures, for example, picture-based identification can give stream recognition, separate checking, and Hard assessment even it did not give exact ID of flexibility design of people. For time being dynamic strategies like radio frequency identification labels are used for detection and separating radio frequency identification. In this project, we showed that how Bluetooth low energy (BLE) labelling used for elective technique is shown. BLE label set points are used for promotion mode and it is identified by mobile phones. (Bluetooth Low Energy, conversationally BLE, some time ago promoted as Bluetooth-Smart app) is a remote distinct territory network transformation planned and given announcement by the Bluetooth Special Interest Group focused on novel applications in the clinical administrations, wellbeing, reference focuses, security, and home news sources.
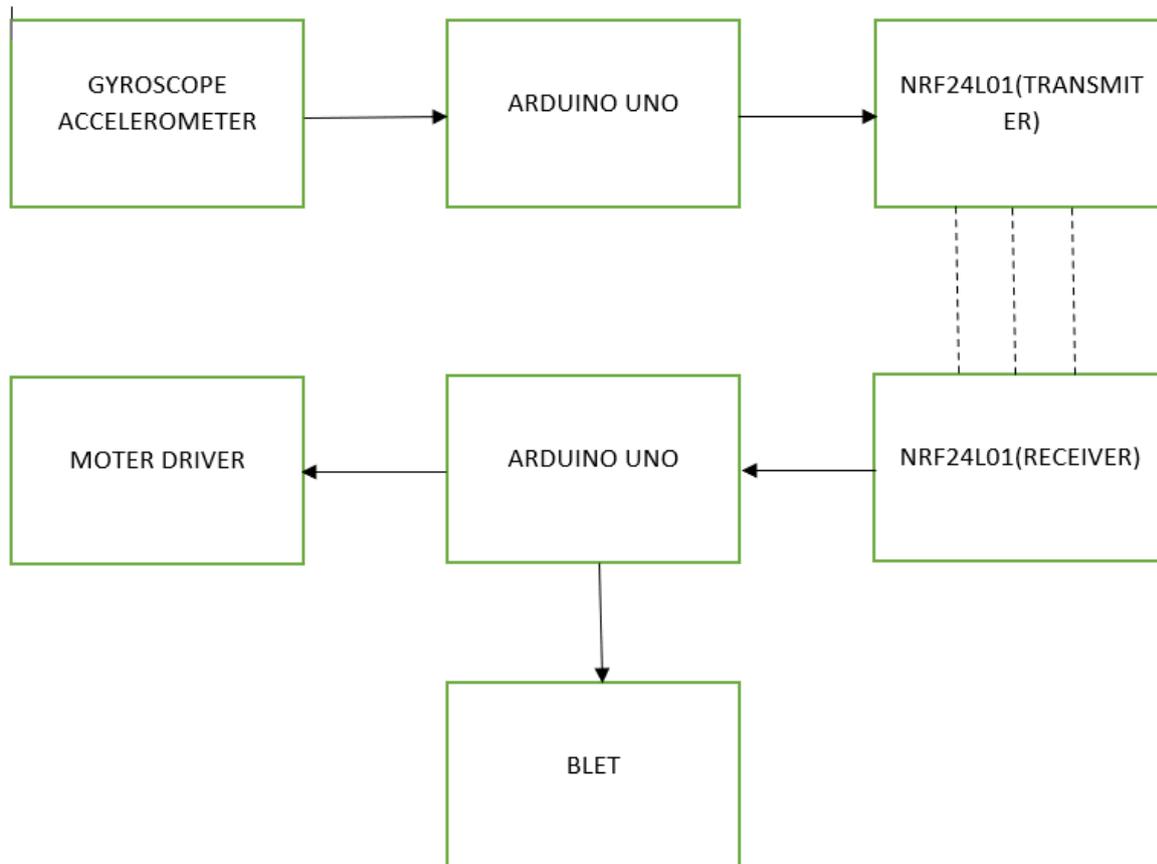
Figure 1: Architecture of Proposed Robot Transmitter and Receiver

Stood out from Classic Bluetooth, BLE needed for giving broadly diminished power use and cost while keeping up an equivalent correspondence broaden. Versatile working structures like Android, iOS, BlackBerry, Windows Phone just as Macintosh OS, Linux, Windows 8 and Windows 10, for locally upholding Bluetooth Low Energy. The Main Reason of the mixing the BLE Tags with Robot is to help the soldiers who are at the border of the country, so that at the time of war they can move their robots by their own wish so that they can know where the Land Mines are present and can see the robot status in mobile app. The main purpose of construction this robot is it was used in military applications [29]. We can detect the land mines by adding landmine detector to this robot. By using this robot without any human interference, we can detect land mines without any danger to human beings. Coming to the nrf24l01 sensor works up to 150-200 meters. The nRF24L01+ handset module imparts and gets data on a particular repeat called Channel. Moreover, all together for in any event two handset modules to talk with each other, they ought to be on a comparative channel. This channel could be any repeat in the 2.4 GHz ISM band or to be more careful, it could be between 2.400 to 2.525 GHz (2400 to 2525 MHz). Each channel includes an exchange speed of under 1MHz. This gives us 125 possible channels with 1MHz partitioning. Along these lines, the module can use 125 particular channels which give a probability to have an association of 125 openly working modems in a solitary spot. Remote controlled robots are valuable in numerous applications like far off observation, military and so forth. Hand signal-controlled robot can be utilized by genuinely tested in wheelchairs. Hand motion controlled mechanical evaluation automated arms can be created. These robots are utilized in clinical applications [30] with the end goal of medical procedure. These robots are utilized in the

development field. These mechanical technologies are utilized in enterprises to control streetcar and lift. This innovation progresses in registering sensor gadgets, materials and handling/characterization strategies will make the up and coming age of this gadgets less expensive, all the more impressive, adaptable and more omnipresent.

Table 1: BLE tag detectability

BLE Tags	Count
Distributed	2
Detected	2(100%)
Detected in defined regions	2(100%)

The investigation was acted regarding BLE labels perceptibility and the effective course recreations. Table 1 shows that we had the option to recognize ~100% of the dispersed labels. We further separated the data to remove area in the foreseen areas. Assembled follows were affirmed against two possible area successions, approximately 100% of the appropriated marks were recognized in the portrayed areas, while only a subset of them follow the typical locale demand as showed up in Table 1. The names which were unquestionably not recognized in expected zone demand were either 1) not in stretch out of the pro contraption 2) didn't follow the right plan while exploring through regions 3) were perceived to be outside the checked regions as a result of GPS screw up on pro device. Two additional cases are used anyway are more freakish since they are performed based on wide tests before examination: 1) couple of names may not turn into dormant 2) mobile phone applications did not run, aimlessly picked amount of examinations for pro contraptions. Number of expert devices are taken into consideration for mindful decision, further it will help for improving detectable quality rate altogether.

A case of user/robot engineering is the correspondence among Smartphone and Beacon: The cell phone (user, with a Bluetooth 4.0 chip or higher) holds tuning in to the channel where the Beacons (robot) send their own Advertising. When it gets an Advertising, the Smartphone can play out an association with each or more Beacons in turn (maximum 8). By staying lethargic more often than not, Beacons have an incredibly decreased battery utilization contrasted with a Bluetooth Classic gadget (likewise because of the limited quantity of information sent during the association and the torpid period). This permits these gadgets to be controlled by little vitality sources, (for example, a coin-cell), and to have a long future (from months to quite a while). The Bluetooth Low Energy Protocol (otherwise called BLE or Bluetooth Smart), was first presented by Bluetooth SIG alongside the Bluetooth 4.0 rendition (2010).
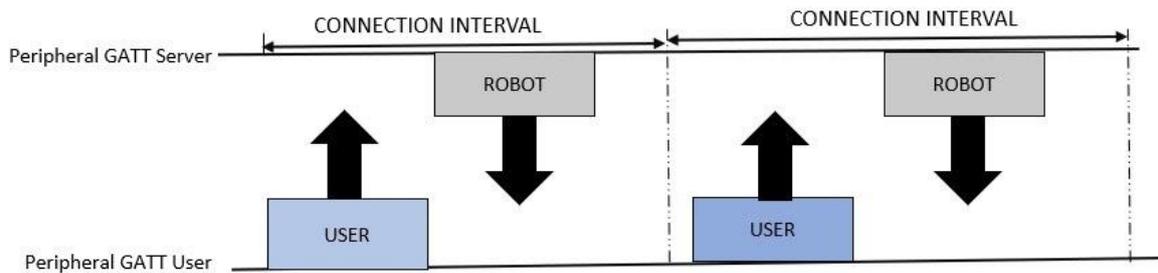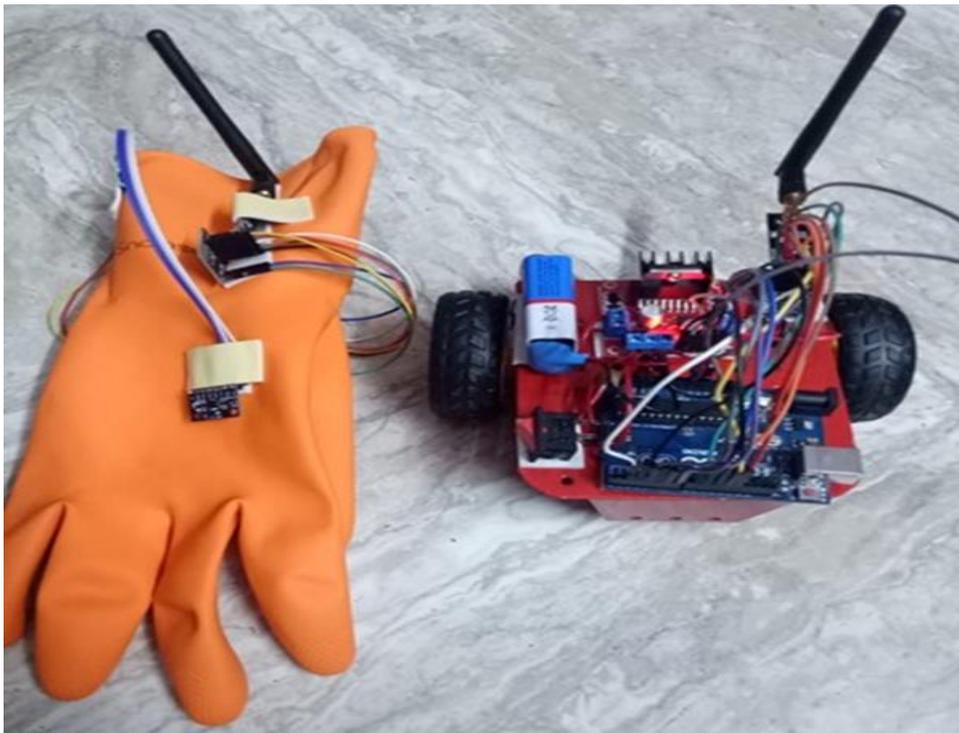
Figure 2: User and Robot Interface

Figure 3: Hardware Module

The BLE convention permits a remote information move with "low vitality" gadgets (Beacons); once in work, they hold tuning in to the channel until a gadget demands an association with them. BLE Beacons broadcast information parcels by means of remote (through the 2,4GHz band) scattered by configurable time periods (Broadcast Interval). This produced information string is called Advertising Packet. The association with the Beacon happens through the Master/Slave rule. (a similar standard utilized by Bluetooth Classic). The user has the activity to deal with the correspondence (start, synchronization, end), while the robot just plays out the Master orders. The user can open different associations with Slaves one after another, yet a robot can be associated with just each user in turn.

Hardware Module that we used in this experiment. These robots are utilized in military applications to work robots. These robots are utilized in clinical applications with the end goal of medical procedure. These robots are utilized in the development field. These mechanical technologies are utilized in ventures to control streetcar and lift. NRF24L01 Transceiver Module uses 2.4 GHz band and further it works from 250 kbps up to 2 Mbps baud rates. If it is used in open space with lower baud rate it can use up to 100 meters.

EEPROM represents Electrically Erasable Programmable Read-Only Memory. The microcontrollers utilized on a large portion of the Arduino sheets have either 512, 1024 or 4096 bytes of EEPROM memory incorporated with the chip. This memory is non-unpredictable, which implies that the information doesn't get eradicated when the board loses power.
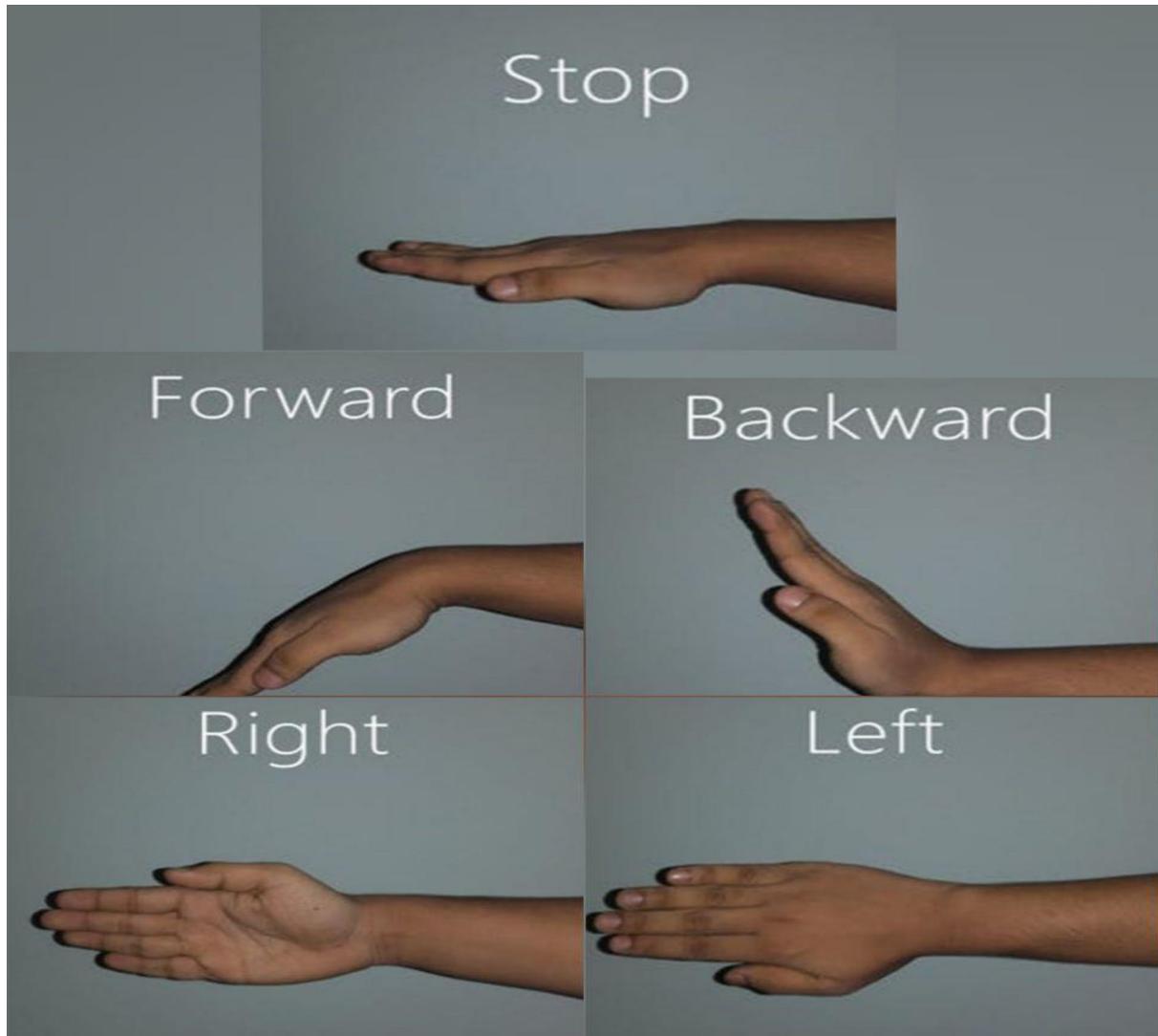

Figure 4: Motion of Hand

By showing these signs we control the movement of the robot. Gyroscope and Accelerometer placed on the hand sensed the tilt made by the hand. Gyroscope and Accelerometer have can easily know how fast the speed of object is changing. This tilt corresponded to the analog voltage. Using this voltage, control signals are generated for four directions of the robot car.
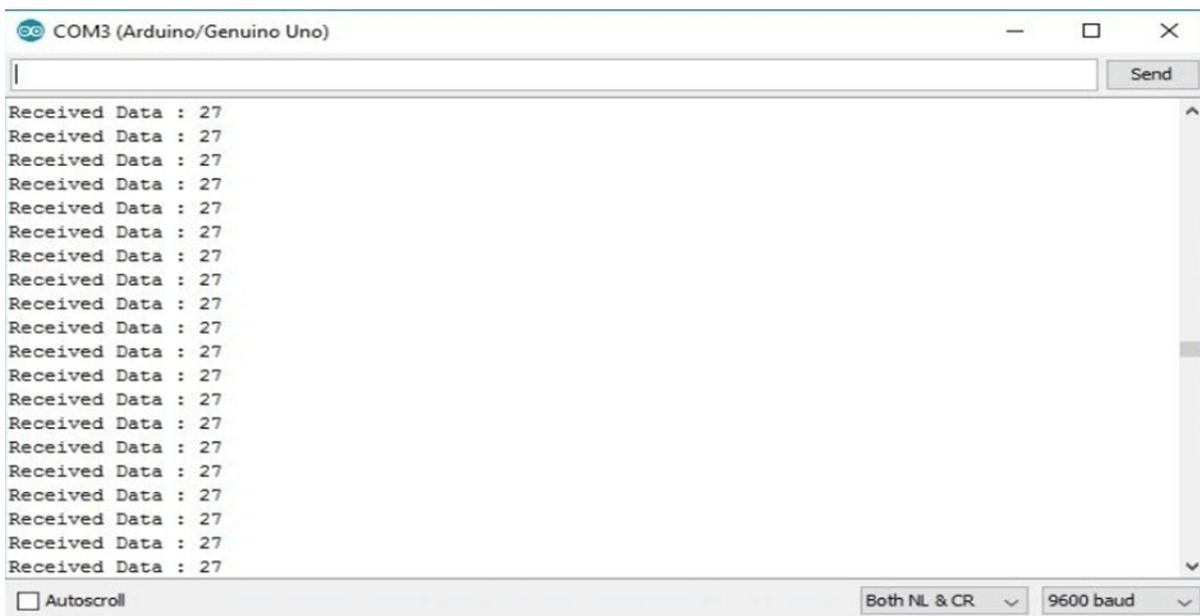
Figure 5: Transmitting Data Through NRF23L01

Figure 6: Receiving Data from NRF23L01

Figure 7: Bluetooth Low Energy Tag

This is where we can see the result of the movements. BLET (Bluetooth Low Energy Tag) is utilized to identify the area of the robot. Robots are additionally furnished with an ultrasonic sensor for keeping away from impediments during route. Realizing robot elements in robots is a difficult task. Detached detecting methods, like individuals checking, camera-based detecting can give stream discovery, and thickness assessment, these are used for exact precise of people ID for portability designs. To perform detection, dynamic strategies like radio frequency identification (RFID) tags are used for identification of individual users. Bluetooth low energy (BLE) is used in this paper and it is labelled as elective strategy. BLE labels set points are used in promotion mode and it is identified by mobile phones. Previously Bluetooth low energy is used as Bluetooth smart for individual territory remote network innovation planned and showcased by Bluetooth Special Interest Group (Bluetooth SIG) in medical care focused on novel applications, wellness, security, guides, and home media outlets [11]. Both Bluetooth and Bluetooth Low Energy take a shot at a comparative band (2,4GHz). Both Bluetooth and Bluetooth Low Energy utilize the User/Robot design: first you need to make the association, then the correspondence can begin. BLE gadgets work in Sleep Mode, so they wake up just if an association demand is sent, that permits them to have a more extended term than a Bluetooth Classic gadget. BLE gadgets permit a quicker association and a more monetary expense than a Bluetooth Classic gadget, however they have a lower information throughput and a lower understanding separation.

4. Conclusion

Our exploratory comes about show that robot portability recognition is capable to detect offloading for performing outer cell phone distinguishable in vicinity BLE gadgets. Flexibility of robot and Bluetooth joins lack of quality is considered less when compared to perceptibility rates (90%). In BLE labels application advanced trouble detection form cells are decreased by proposed method demonstration. We had the option to show incredible recognition results that demonstrate the legitimacy of the methodology for detecting huge scope robot. By presenting versatility in a few or all hubs in the remote sensor organization, we diminished the quantity of hubs and accordingly decreasing the expense of the general framework. These portable sensor hubs move in the climate without human intercession. nRF24L01 convention is utilized for the dependable conveyance of the sensor information. Advanced Image handling is utilized to distinguish weeds and shower herbicides on them utilizing Solenoid valve. The normal precision of the framework is about 93%. To make the robot independent, we utilized Ultrasonic sensors. Entire of the obtained information from the sensors is shipped off web utilizing Internet of Things (IoT) innovation by presenting MPU module in the framework. The proposed framework is completely independent however in coming future this work can be explained by presenting a portable application. Henceforth the robot can work independently or physically through versatile application, on client request.

5. References

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