IoT Based Low-Cost Robotic Agent Design for Disabled and Covid-19 Virus Affected People

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***Abstract*—Disabled people and Virus affected patients can be helped through Internet of Things and Robotic systems in this modern era. Recently the whole world is suffering from the Covid-19 pandemic. The virus affected and disabled people are helpless because caregivers, doctors and other people are afraid of the contagious virus. This work will result in an IoT based Robotic agent which will be able to help disabled and virus affected people with low cost systems. The robotic agent will be able to recognize the patient's Gesture and follow instructions through it with 360-degree movement. Without image processing the system is made with MPU 6050 Accelerometer Gyroscope sensor for Gesture Recognition. Radio Frequency communication was used to make the system wireless.**

Keywords— Wireless Robot, Gesture Recognition, IoT, Covid-19, Disable People.

I. Introduction

Among different types of robots, gestures robots are one. Recently, hand gesture recognition robots have been getting a lot of attention. Thanks to its application and the ability to communicate efficiently with machines via human robot association [1]. Nowadays gesture control robots are acting as a helping hand to a disabled human. Many organizations and companies are trying to create an algorithm, they have created some graduates for this purpose. Human robot interaction (HRI) used in hand gesture recognition that creates an interactive interface that is simple and easy to manage [2]. The video method explicitly discusses the hand gesture system. The paper de-sign a pose control automation that can chase hand gestures and work with the data which is transmitted from hand wirelessly. Hand gesture robot used some wearable sensors such as data gloves and also used some exotic sensors like a video camera. Data gloves can give an accurate dimension of hand gesture and behavior. But it is very expensive because it requires wide calibration and limitation of natural hand activity. At present video basis gesture acceptance found these problems but it also presents a new problem: Allocating the hands and parting them from the background in an image series is a difficult task. [3] and [4] describe video-based systems. Complex images are sensed with the depth cameras such as the ASUS Xtion, Microsoft Ki-nect, or Mesa Swiss Ranger, or extracted from stereo video cameras, giving an alternative function where they can perform in several environments.

The rest of the paper is organized as follows: related research has been presented in section II. The system model and methodology have been presented in section III. Obtained results and related discussion have been presented in section IV, while conclusions and future works have been outlined in section V. The acknowledgement is stated before references.

II. Literature Review

Authors of [5] offer an outline of the relationship between human computers. While developing a human-machine interaction system, functionality and usability two features are used. Unit configuration applies to a collection of tasks designed for the users by the program. Although the efficiency of the program addresses the extent of complexity the device can easily transfer of execute different consumer purposes. Authors of [6] introduced two techniques for gesture systems and these two types are information about the edge, the segmentation. Such system design is categorized into three major stages, and they are algorithms for image preprocessing, retrieval of data, and identification. Authors of [7] has suggested a recognition system to use in mobile robot applications. In this paper, pattern recognition was done using the FCM algorithm. The Fuzzy C-Means algorithm gives sufficient speed and authenticity to carry out the task. The distance be-tween the user and the camera was also shown here as being one meter. Authors of [8] gave special features on hand and facial expressions in a study about gesture control. All these particle filtering, condensation and hidden Markov models, finite-state machines, optical flow, skin color, and connectionist models are covered in depth here. This study utilized HMM, ANNs, FSMs, particle filtering, and condensation algorithms. Authors of [9] provided a system for gesture control utilizing boundary chord size histograms for specification attributes and multilayer perceptron neural network classification. Three classification methods have been met by the system which are computational time, memo requirement and classification accuracy. Here had used quick search start point algorithm which gives the system a property of rotation invariance. Authors of [10] described the use of hand postures and gestures as a way for interaction with computers, describing both skill for executing accurate recognition and the technological future innate to posture and gesture-based interaction. Two methods of gathering raw data are used by the system: one is just a glove control tool and the other is machine vision. This program is spitted into 3 separate levels. The first level is extraction of functions, figures and templates, the second class is studying algorithms and the third class is techniques of miscellaneous. Authors of [11] provided review of the methods for recognizing hand gestures and gestures. The key methods included in these programs have been the thorough review of FSM, PCA, HMMs, and

ANNs. Authors of [12] discussed the human motion capture system. New technology is used for capturing the motion. These technologies are cameras, magnetic trackers, and computers. Authors of [13] discussed different types of segmentation techniques. A statistical model based on skin coloring described in detail with different segmentation models. GMM classifier discussed in this paper because it provides adoptable performance with the minimum training data set and required low storage system. Authors of [14] proposed a system based on the Hidden Markov Models that can recognize an isolated constructive expression from the ongoing hand movement for the Arabic numbers 0 to 9 in real time. Authors of [15] suggested a new hand gesture recognition system based on the characteristics of the gesture and filtering of neural network shape. The region of the hand is isolated in color space YCbCr. This is a very quick process which results in a noiseless segmented image. An IoT based system is designed for Alzheimer's patient was introduced by [16]. EVS systems [17] are also using IoT and Robotics [18]. We can sense remote data with IoT based Robots [19]. Robotics and IoT may contribute in farming [20] and fruits [21] cultivation. Robots can be used as Nurse [22] in hospitals, this robot may have gesture recognition [23] and remote sensing [24] ability.

III. Methodology and System Design

A. Features

The designed robot can follow hand gestures and move 360 degree by the signal which is transmitted from hand wirelessly. This system is less expensive than an image processing method. Measuring the movement of the human hand by the MPU6050 Accelerometer Gyroscope sensor. Radio Frequency communication is used to send the collected data from hand to the robot. Hand module sends data after encoding. Then the robot receives the data via 433KHz Radio wave and decodes it. The decoder decodes it and sent it to the motor driver. Following this instruction, the robot can move backward, forward, left and right direction and this movement is controlled by the motor driver. The robot can go to the virus affected people and help them also will be able to collect data from them.

B. Algorithm

The system follows this algorithm:

Step 1: Start the robot and hand module.

Step 2: Establish connection between hand module and robot via 433KHz Radio communication.

Step 3: MCU6050 collects hand gesture data.

Step 4: MCU6050 sends gesture data to Arduino Nano.

Step 5: Arduino Nano Process the data and recognizes the gesture direction.

Step 6: Arduino Nano sends the gesture data to radio communication module.

Step 7: The radio module encodes the data with encoder IC.

Step 8: After encoding the data transmit through radio wave transmitter.

Step 9: The receiver circuit situated in robot receives the signal and decodes the data.

Step 10: The motor driver receives the decoded data and drives the motor for any movement after getting power from battery.

Step 11: After these the robot moves with the gesture.

Step 12: If not sensed the data then stop it.

C. How it works

The system works as the mentioned algorithm by following the block diagram mentioned in (Fig. 1).

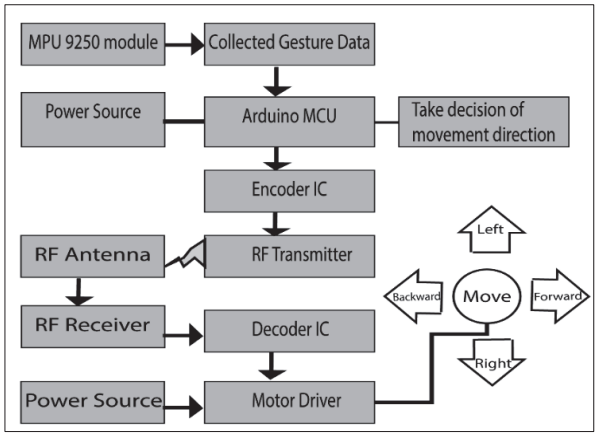

Fig. 1. The system block diagram following the algorithm.

The hand module has an Arduino Nano microcontroller, MPU6050 Accelerometer Gyroscope, HT-12E encoder IC, 433KHz radio wave transmitter, Antenna, Indicator lights, resistances, connectors and battery (see Fig. 2).

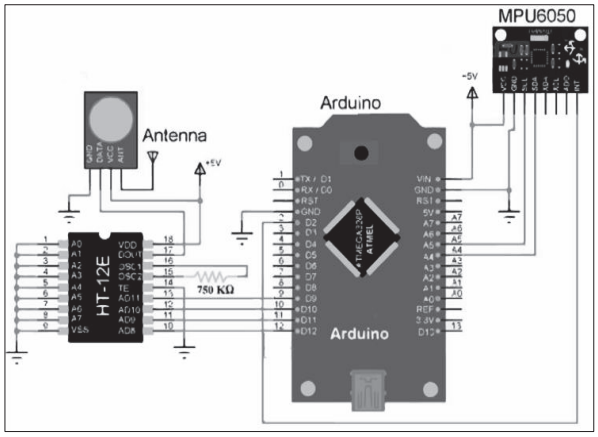

Fig. 2. The gesture recognizer hand module with transmitter and encoder.

The receiver module is situated in the robot has an L293D motor driver IC, DC gear motors, HT-12D decoder IC, 433KHz radio wave receiver, Antenna, Indicator lights, resistances, connectors and battery (see Fig. 3).

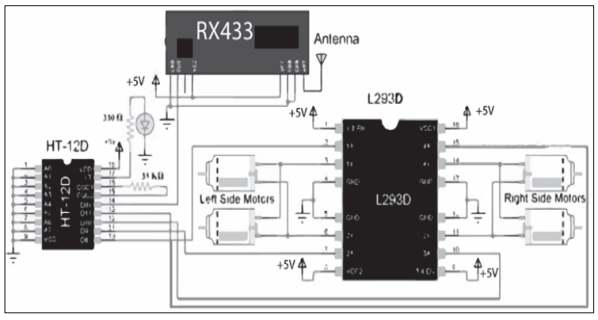

Fig. 3. The gesture recognizer hand module with transmitter and encoder.

IV. Results and Outcome

The hardware prototype with Arduino nano microcontroller, gesture recognizer module and receiver robot are shown in (Fig. 4).

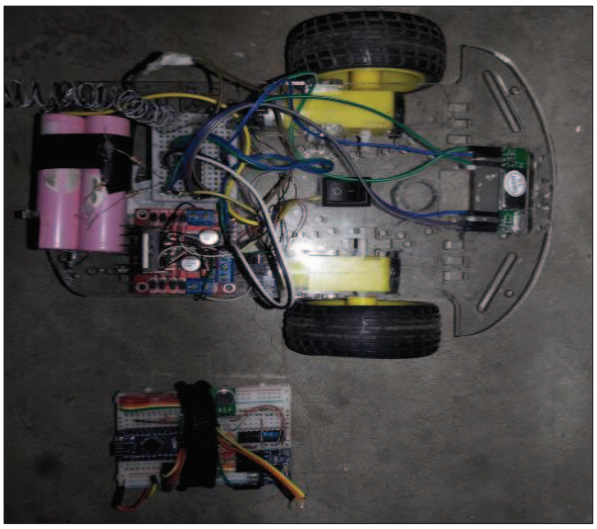

Fig. 4. Designed prototype with transmitter, receiver and robot.

This is a gesture-controlled robot that can follow anyone's hand gesture and works with the data which is transmitted from hand wirelessly. We can set the transmitter module with any other organ like leg or head, then it will recognize gesture from there too. It can measure the gesture and identify the direction of the movement. It encoded the gesture data and sent it via RF transmitter. Receive through RF receiver and decoded the data. Following this decoded data, the gesture robot can move 360 degrees. It will be helpful for those people who are physically disabled and affected by virus like covid-19. We have made a video of implementation of the robot prototype which is uploaded here: https://youtu.be/NDRwFn2XRJs . The successful movements of the prototype have been mentioned in (Fig. 5).

Fig. 5. Designed robot prototype and successful movements.

We have tested the robot as follows: Test point 1: Gesture recognition. We have tested for 1000 times and the system recognized the correct gesture for 979 time. So, the success rate is: 97.9%.

Test point 2: Gesture Data sending and Receiving. We have tested for 1000 times and the system recognized the correct gesture for 981 time. So, the success rate is: 98.1%.

Test point 3: 360-degree movement. We have tested for 1000 times and the system recognized the correct gesture for 992 time. So, the success rate is: 99.2%.

V. Conclusion

This paper represents a wireless gesture control robot for people who are physically disabled and virus affected. It can follow the hand or other organ's gesture and works with the data wirelessly. So, the system will be helpful for the disabled and virus affected persons. Where other people are afraid of going near to virus affected people there this robot can serve. The system can be implemented with the wheel-chair so they can move one place to another place.

We have some future work plan for this work as follows:

- In our future work we will add some more features like voice controlling, line following, obstacle avoiding.
- We will add some advanced sensors that can check the user's health condition.
- We have some plan for machine learning and Artificial intelligence to integrate with this robot.

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