A Gesture Controlled System

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ABSTRACT: Recently, strong efforts have been made to bridge the gap between human and computer-based system by making the interactions (which were via input devices like keyboards and mouse) as natural as possible through gesture controls. Gesture recognition is useful for processing information from humans which is not conveyed through speech or type. The main objective of this work is to control a robot with gestures of our hand. There are two main components that are used in the system, an Arduino microcontroller and an accelerometer. The accelerometer depends upon the gestures of our hand. Through accelerometer, a passage of data signal is received and it is processed with the help of arduino microcontroller. The microcontroller gives command to the robot to move in the desired direction. Accelerometer-based gesture control is studied as a supplementary or an alternative interaction modality. Gesture commands freely trainable by the user can be used for controlling external devices with handheld wireless sensor unit. Gesture commands were found to be natural, especially for commands with spatial association in design environment control. The work consists of the integration of three technologies as wireless, gesture & embedded.

KEYWORDS Gesture control, Arduina, Wireless, Graphic User Interface, Microcontroller

INTRODUCTION

Gestures provide an intuitive interface for both human and computer. Thus, such gesture-based interfaces can not only substitute the common interface devices, but can also be exploited to extend their functionality [1]. In the early years of robot technology, the only way to communicate with a robot was via program. This required extensive hard work on the part of the programmers and developers. With the development in science and robotics, gesture based recognition came into life. Gestures originate from any bodily motion or state but commonly originate from the face or hand. Gesture recognition can be considered as a way for computer to understand human body language. This has therefore minimized the need for text interfaces, button-based controls and Graphical User Interface (GUI) [2]

TECHNOLOGY

Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current focuses in the field

include emotion recognition from the face and hand gesture recognition. Many approaches have been made using cameras and computer vision algorithms to interpret sign language.

Using the concept of gesture recognition, it is possible to point a finger at the computer screen so that the cursor will move accordingly. This could potentially make conventional input devices such as mouse, keyboards and even touch-screens redundant. Gesture recognition can be conducted with techniques from computer vision and image processing. In computer interfaces, two types of gestures are distinguished: We consider online gestures, which can also be regarded as direct manipulations like scaling and rotating. Figure 1 illustrates the hand gesture movement.

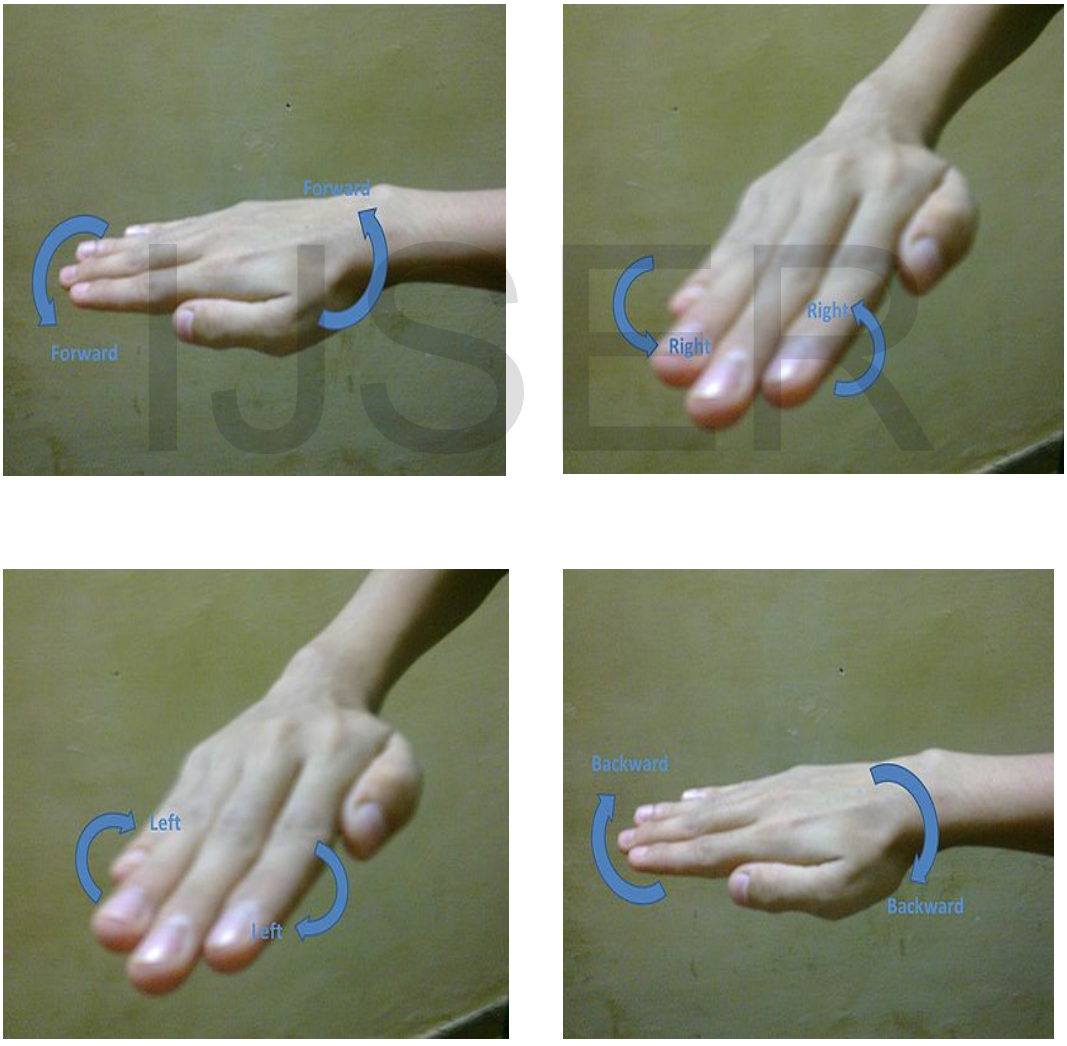

Fig 1: Gesture movement diagram

PROJECT OVERVIEW:

The objective of the project is to be able to control the direction of movement of a simple robot with hand gestures. This is accomplished with two major components which are Arduino microcontroller and an accelerometer. The basic working principle of the project involves the accelerometer transmitting the hand gesture measurements to the Arduino microcontroller which processes it and tells the robot to move in the desired direction.

SCOPE OF THE PROJECT:

The overall aim of the project is to make the robot capable of understanding human body language, however limited, thereby bridging the gap between machine and human. Our objective is to also make this device simple as well as cheap so that it could be mass produced and can be used for a number of purposes like enabling an individual confined to a wheelchair to be able to move about freely without the stress of pushing the wheel or requiring assistance from someone else to using gestures to control home appliances.

PROJECT STATEMENT:

The wireless gesture controlled robot involves two overall gadgets which include the gesture controller that is worn on the hand and the robot itself that is to be controlled via hand gestures. The gesture controller consists of the accelerometer (ADXL335), Arduino microcontroller (ATmega328), encoder IC (HT12E) and a Radio Frequency (RF) transmitter module. The accelerometer measures the tilting of the hand and sends the analog values to the microcontroller which processes the signals and converts them to digital form which are then encoded by the encoder IC and sent to the transmitter module for wireless transmission.

On the robot, there is a Radio Frequency (RF) receiver module, a decoder IC (HT12D) and an actuator IC (L293D) [3]. The receiver module receives the wireless transmission from the RF transmitter on the gesture controller and the information is decoded by the decoder IC and sent to the actuator IC which serves as an interface for the robot motors and tells them what to do based on the processed information.

STATEMENT OF THE PROBLEM:

There is a need to create a much more convenient means of communicating with machines that would feel more natural to human users. The traditional methods of doing so involved the use of keyboards, mouse and other controller I/O devices to control machines. These methods had some bottlenecks of which include the complexity of the controller device and the generic unnaturalness of the interaction as a whole, and the series of wired connections which limits the

range of operation of the machine by the user. This project aims to demonstrate an easier and efficient way of interacting with machines.

ADVANTAGES:

- This mode of interaction with machines is more natural as opposed to the traditional use of keyboards and mouse since it greatly reduces the complexity of operation.
- Gesture controlling is very helpful for handicapped and physically disabled people to achieve certain tasks, such as driving a vehicle or moving about in a wheelchair without needing to manually push the wheels themselves [4]
- Gestures can be used to control interactions for entertainment purposes such as gaming to make the game player's experience more interactive or immersive [5]
- It does not require GUI to be functional which further emphasizes the simplicity of gesture controls.
- The machine can be remotely controlled from a distance when high RF transceiver modules are implemented.

DISADVANTAGES:

- The machine cannot recognize the start and end points of meaningful gestures from continuous motion of the hands [6]
- This technology is most suitable in a controlled lab setting.

METHODOLOGY:

The primary goal in designing a simple wireless gesture controlled robot was to make it as simple as possible with minimal resources while still achieving our objective of controlling the robot's movements with the gestures of the hand. Thus, based on the aforementioned criteria, the following main components were used:

For the gesture controller,

1. ADXL335 3-axis accelerometer
2. ATMEGA328 microcontroller
3. HT12E 2^{12} series encoder
4. 433MHz RF transmitter module

For the robot itself,

1. 433MHz RF receiver module
2. HT12D 2^{12} series decoder IC

3. L293D motor driver IC

THE GESTURE CONTROLLER:

The design of the gesture controller makes it wearable on the wrist/hand for convenience of operation. Block diagram representations and the flow charts of the transmitter and receiver section of the gesture control system are shown in the figure 2.

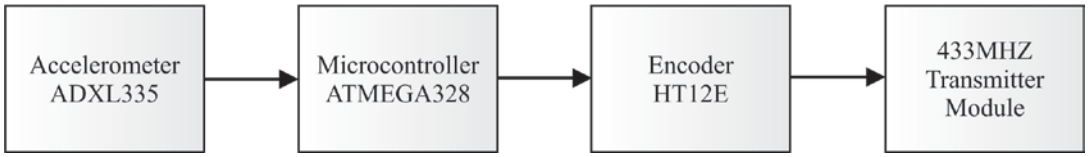

Fig. 2: Block diagram of the Transmitter

To briefly summarize, the accelerometer measures the angle of hand tilts and passes on these values to the microcontroller as analogue values which are then processed and converted to digital form and encoded by the encoder IC to eliminate interference of the 433MHz transmission. Figure 3 is the flow chart of the gesture controller:

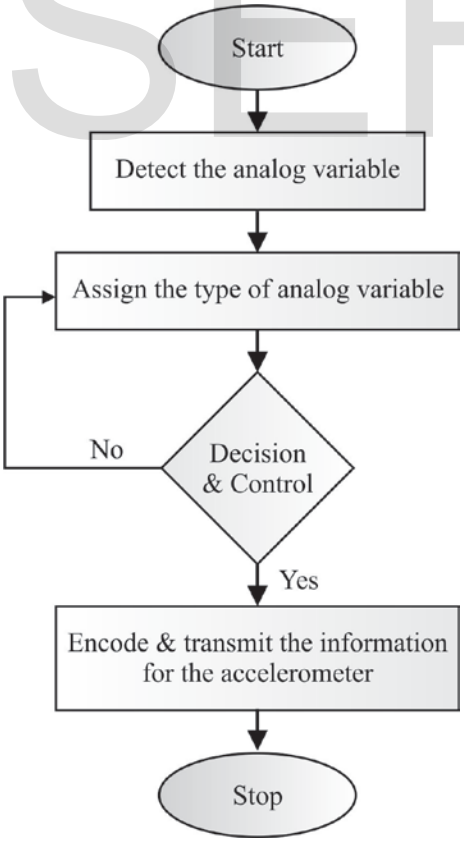

Fig. 3: Flow Chart of the gesture controller/transmitter

Analysis: At the start, the gesture controller is switched on. The main function of the accelerometer is to measure the degree of tilting of the hand gestures. The values of the measurements are analog variables and are more or less useless at this point. These analog variables then get transferred to the Arduino microcontroller. The microcontroller on the Arduino is programmed to recognize a set of analog variables from the stream of analog values it will receive from the accelerometer and assign specific functions to them according to its programming. In the decision and control part, the microcontroller's Artificial Intelligence (AI) system begins deciding which of the analog variables matches its preprogrammed values and to which it assigns the function which is a LOW or HIGH output. If the microcontroller cannot find a match, the variables are discarded and it waits to receive newer measurement values from the accelerometer. This loop continues until a match is found. When a matching variable is received, the microcontroller assigns the appropriate function to it and passes on the information in digital form to be encrypted by the encoder IC which is then transmitted at a particular frequency (in this case 433MHz). This breaks the loop.

THE ROBOT:

The robot moves via a set of wheels attached to DC motors which are controlled by a motor driver IC as depicted in figure 4 and the flow chart in figure 5.

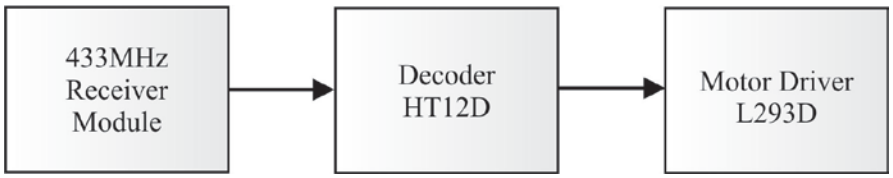

Fig. 4: Block diagram of the robot showing its components

Information transmitted at 433MHz is captured and sent to the decoder IC for decryption. The decrypted information is passed on to the motor driver IC which serves as an interface for operating DC motors and is the flow chart of the robot.

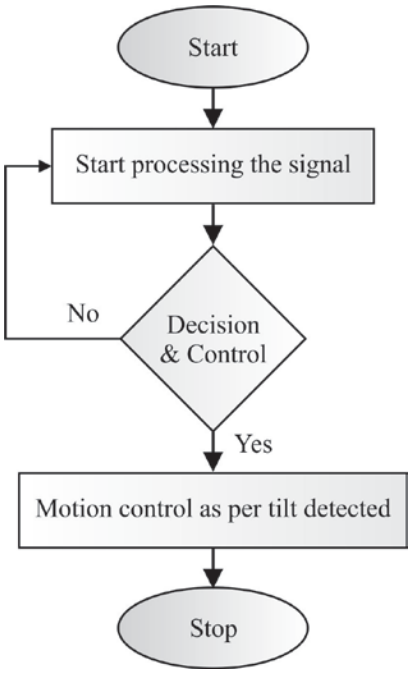

Fig. 5: Basic Flow Chart of Receiver

Analysis: At start the robot is switched on. The RF receiver module on the robot remains on standby ready to accept any information being transmitted through the air at its frequency channel. Any information that is not on that particular frequency is ignored. In the decision and control part, the information received at 433MHz is sent to the decoder IC which commences the decryption process. At this point, the decoder is expecting information that is encrypted by an encoder IC of the same cryptology pattern as its decrypting process. If the encryption cannot be decoded, the decoder discards the information and awaits another encrypted data to be sent. If the information is not encrypted at all, it is also discarded. This loop continues until the decoder receives encrypted information that matches its decryption process and then commences with decoding the information. The decoded information, which is the original digital processed data sent from the microcontroller to the encoder IC, is then sent to motor driver which controls the movement of the motors according to the information it received. At this point, the loop is broken.

Finalizing the decision of making a gesture controlled robot that will be maneuvered by a hand gloved mounted with the transmission circuit assembly. The circuit assembly will consist of accelerometer & Arduino board along with an RF transmitter, which together function as an input device. We decided on this project because we wanted to do a basic application of

controlling a vehicle with your hand. The controls of our robot are based on gesture of hand, which becomes simple for any person to handle it. The basic working principle for our robot is passage of the data signals of accelerometer readings to the Arduino board. While we have used two-axis accelerometer. In which, one axis will control the speed in forward or backward direction and other axis will control the turning mechanism, the system is shown in figure 6.

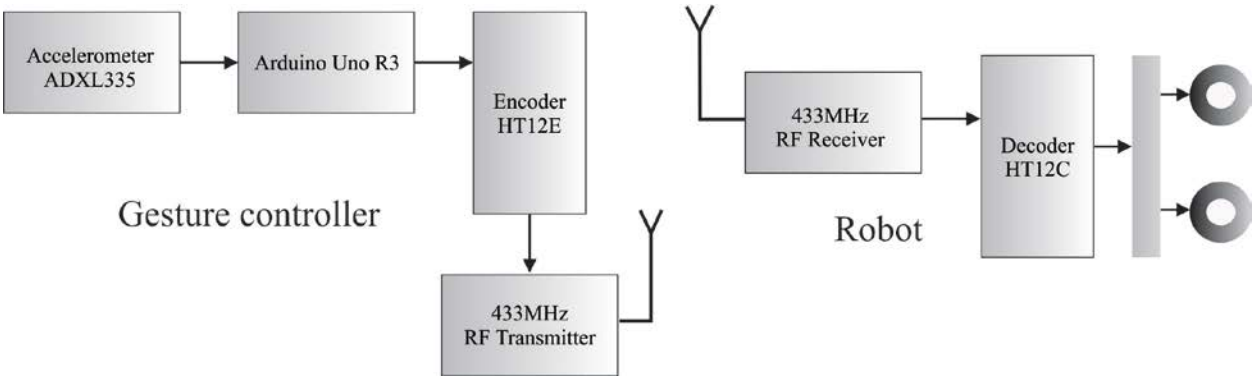

Figure 6: Block diagram of the system

CONCLUSION:

The introduction of robots with integrated vision and touch dramatically changes the speed and efficiency of new production and delivery systems. Robots have become so accurate that they can be applied where manual operations are no longer a viable option. Semiconductor manufacturing is one example, where a consistent high level of throughput and quality cannot be achieved with humans and simple mechanization. In addition, significant gains are achieved through enabling rapid product changeover and evolution that can't be matched with conventional hard tooling.

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