Low Cost Wrist Worn Sensor Based On Gesture Interaction

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***Abstract*— In current days, the line of work of smart electronics and gaming market has developed tremendously scheduled to the availability of outshine sensing equipment's and new dispensation techniques which has to a great extent enabled the review of electronic module (RF, Gyroscope /accelerometer, Arduino etc.). At the moment time optical mouse is old ubiquitously, so container economical method to create improved consumer boundary by means of gestures through wrist. gestures by wrist canister be second-hand for a number of attention like calculating day to day electronic diplomacy such as mouse, keyboard, etc. optical mouse does not offer gestures and good quality consumer come across hence, we aim a wrist tattered sensor, blended with gestures and fun in low cost factor mainly taken into consideration. We produce a control to discriminate the next modes of operation: the mouse mode enables a pleasant client feel based on the wrist gestures and the laying a gaming mode enables client to attach any nature of playoffs that provides hand over on amusement and exciting experience. For the presentation of our undertaking we include the game called Need for speed which basically is a car racing game in which we obtain connected the gesture lobby group to the car movement. We have made the device at a price of INR Rs.1479/- which is quite low as compared with the other high-ends products available in the markets.**

Keywords— Transmitter, Receiver, Arduino Nano, Arduino Leonardo, nRF24L01, Limit Switch, ADXL335, Low Cost, Gestures. Introduction (*Heading 1*)

I. INTRODUCTION

The familiar tool for indicating the cursor against the, examine is by via the mouse hardware. At hand has been an individual reworking in this hardware over existence early from ball mouse, after that the laser optical mouse followed by wireless optical mouse and pronto the as a rule public is the touchpad old in laptops. The prime ideology of the project is to see into the future by creating a mouse hardware that facility on the wrist gestures of the user.

Gaming is multi-billion buck business and the integer of Gaming companies has been growing exponentially every year. Gamers constitute 41.2% of the compute effective internet users in India, huge 89% increase in intensity from 2007. With the innovation in technology, having a gaming styles keeps on altering with growing gaming world thus, required advance to stack step with the newest trend. But the obtainable plans stress extra on liability effects and take away on fun. Hence, we propose a Wrist-worn sensor, blended with gestures and fun, to hand a new client experience.

Fig. 1. Implementation of Receiver and Transmitter module.

A. Innovations and Usefulness

1) This gadget is fit for relations of each and every one ages and to bring masses of fun.

2) Owing to the piece of information that electronic campaign such as mouse, keyboard etc. are important in day to day world, this maneuver will make better the user's Perspective and correctness of the player.

3) This expedient serves as the archetype platform for erudition about the components that make for into manufacture a wireless wrist sensor by means of gestures and would produce us the essential skills desired to be successful in life.

B. Key Feature

1) Low cost as compare to the High-end products available in the market.

2) Due to its 5000mAh battery, if we charge it for 2-3hrs it device can run for at least 2-3 days without charging it again.

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3) This device is fully User friendly i.e. Plug and play, any user without having any programming knowledge can handle it effectively.

C. Industrial & Future Applications

1) Designed especially keeping in mind the need for cheap and effective devices in the market by the users, accordingly with the user's needs.

2) Currently the device can be used as a mouse and for gamming purpose, in future we thought of expanding its handling capabilities for the movable devices like RC car or even real car.

3) Industry mainly targets for the cost and the reliability factor in making the device which is also taken care by us while building such gesture based device.

II. FLOW CHART

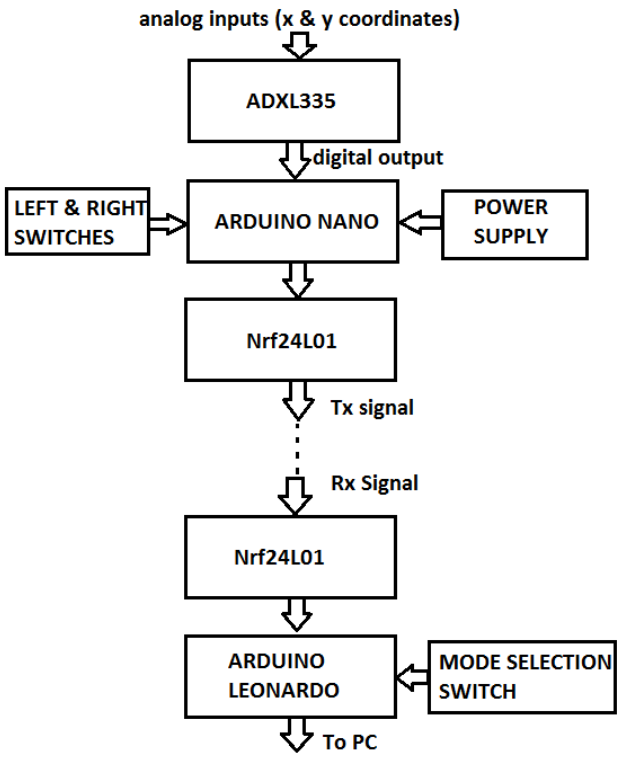

Fig. 2. Work Flow Chart

From the beginning of the flow chart it can be seen that it is divided into two part, Top half defines the working of TX whereas the other half defines the working of RX. The analog inputs i.e. gestures are captured by the ADXL335 which is a build in gyroscope cum accelerometer and gets converted in to 3 axis coordinates. Avoiding one axis (z coordinate) of the 3 axis coordinates we only use 2 axis (x & y coordinates) for our device working which mapped to the microcontroller i.e. Arduino Nano. As the practical mouse requires left & right clicks for the operation, the limit switches are used for the same. All the data is processed by the Arduino Nano which is passed on to the receiver section via nrf24l01 which is a RF module which is also present at the RX end connected to the microcontroller of RX section.

The Arduino Leonardo is the microcontroller chosen at the receiver end on purpose due to its compatibility with the mouse & keyboard libraries of any Computer/Laptops. The 2 axis coordinate data upon receiving are processed and are linked to the libraries which are modified accordingly for the working of the device.

III. DESIGN PHASE

Architectural Design

The device is at odds into two sections i.e. transmitter section and receiver section. The building block and the launch prototype is exposed in "fig. 2" and "fig. 1" respectively.

The transmitter segment consists of arduino Nano, 3-axis accelerometer, power supply, two limit switch and one RF module.

The receiver section consists of arduino Leonardo, one mode selecting switch and one RF module. The transmitter draws its power from external power supply and power to the receiver is certain by PC.

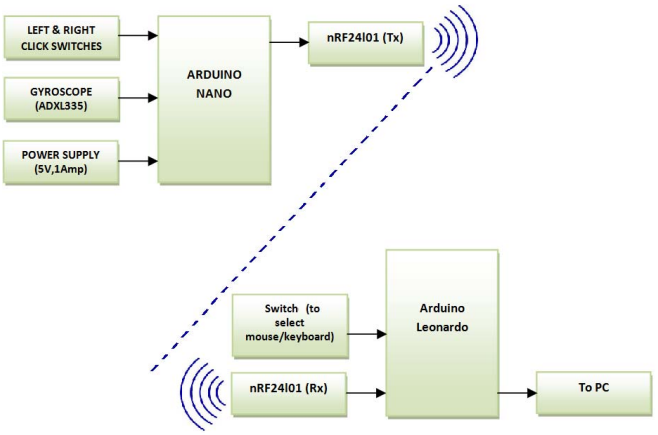

Fig. 2. Block diagram of Transmitter and Receiver.

Firstly, the analog output values are read by the Arduino Nano i.e. X-axis and Y-axis values from the 3 axis accelerometer and converts analog values to digital values. The digital values are processed by arduino Nano and certain to RF transmitter which is at that moment received by RF receiver.

The expected gesture is processed by arduino Leonardo which drives the mouse/gaming controls on computer based on wrist gestures.

IV. DETAILED DESIGN

A. Transmitter

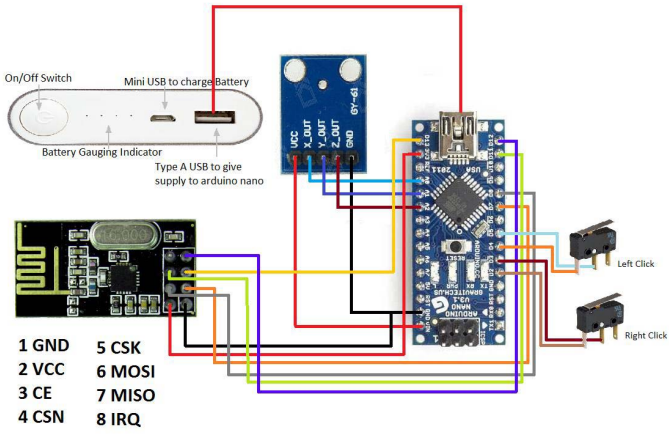

Fig. 3. Connection diagram at Transmitter.

1. GENERAL DESCRIPTION

- The arduino Nano is powered by external power supply having output of 5V, 1Amp via USB cable.
- ADXL335 - The Arduino Nano reads the analog output values i.e., x-axis and y-axis values from the ADXL335 accelerometer and converts analog value to digital values.
  a) X_OUT defines roll which is connected to analog pin A0.
  b) Y_OUT defines pitch which is connected to analog pin A1.
  c) Z_OUT defines yaw which is connected to analog pin A2.

- nRF24LO1-

a) .Packet Format

Preamble (1 byte)	Address (3-5 byte)	Packet Control Field (9 bit)	Payload (0-32 byte)	CRC (1-2 byte)

The transmitter mode is in active mode when the packet is transmitted by the nRF24L01. It has to set the bit high of PWR_UP and set low of PRIM_Rx, there is a payload in the Tx FIFO and for more than 10µs high pulse on CE of nRF24L01 to enter the active mode.

Till nRF24L01 finishes transmitting the ongoing packet it stays in TX mode. nRF24L01 returns to Standby-I mode if CE=0 else if CE=1, determination of next action is done by the status of the TX FIFO. nRF24L01 remains in TX mode is TX FIFO is not empty, next packet is transmitted if the FIFO is empty. The nRF24L01 goes into standby-II mode. When nRF24L01 transmitter is in TX mode it operates in open loop. It is critical to never keep the nRF24L01 in TX mode for more than 4ms at once. In the event that auto retransmit is empowered, the Nrf24L01 is never TX mode sufficiently long to resist this standard. [6]

- Limit Switch:

Here two limit switches are used one for left click and other for right click respectively. Since the connection is normally open, the digital pins of Arduino Nano are high when no connections are made. Hence, to overcome this effect Input Pull-up function is used in the code and then limit switches are connected. When the switch is pressed, it sends a pulse to the digital pin of the Arduino. Based on these pulses going to the digital pins, as specified in the codes for left and right click the desired objective is achieved.

B. Receiver

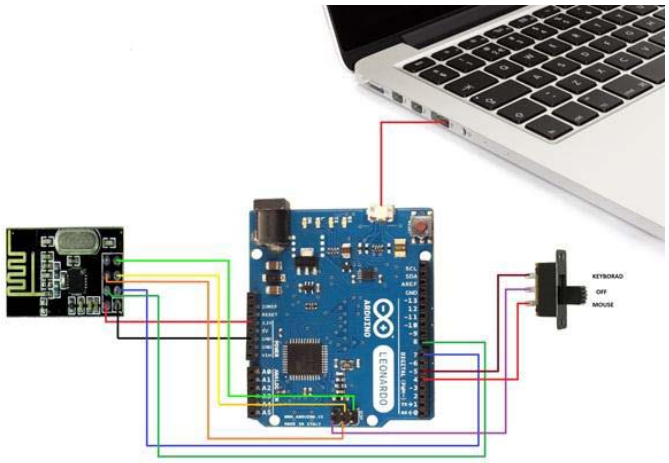

Fig. 4. Connection diagram at Receiver.

1. General Description

- The Arduino Leonardo is powered by PC having output of 5V, 1Amp via USB cable.
- nRF24L01

nRF24L01 radio is a receiver when the RX mode is an active mode. To enter in the active mode, the following bits should be set high i.e. PRIM_RX, PWR_UP & CE pin. The RF channel signals are demodulated in the receiver. Continually exhibiting the demodulated data signal to the baseband protocol engine. Here constantly a valid packet is searched by the baseband protocol engine.

If payload finds a valid packet by matching address and validating, then it is presented in a vacant slot in RX FIFO. The received packet is discarded if RX FIFO is full. Micro controller unit configures the modes i.e. power down mode and Standby-I mode and remains in Receiving (RX) mode. Next the baseband protocol engine for automatic protocol features are enabled i.e. enhanced Shock Burst and it executes the protocol by entering other modes of nRF24L01.

Carrier detect signal is available in Rx mode, this signal has to be set high to detect the RF signal which is detected inside the receiving frequency channel. Secure detection is obtained if the signal is FSK modulated. All other signals are detected as in when RF signal is detected in Rx mode when the Carrier Detect (CD) is set high or else it will be low. Before presenting to CD register the CD signal must be filtered.
The RF signal must be present for minimum time of least 128µs before the CD is set high. [6]

i. 6-pin 3-position sliding switch is used to switch between mouse and gaming control modes.
ii. Arduino Leonardo gets the data bits such as roll, pitch, yaw and controls like left and right click from the receiver nRF24L01 which is processed by the Arduino based on the mode selected by the user

V. IMPLEMENTATION PHASE

A. Hardware implementation

There are two sections as shown in the "fig. 2" i.e.; transmitter and receiver section. In the transmitter section an outer cover of normal mobile power bank (as shown in "fig. 3") is used, were in it contains arduino Nano, ADXL335, nRF24L01 and external battery source in an embedded form. The whole embedded system is placed in a compact manner and the battery source is linked to a chipset which enables to charge the battery source as well as providing a boosted output from 3.3V to 5V. The whole outer case is then mounted on hard cloth band which is made wearable onto the palm of user.
In the receiver section arduino Leonardo is placed along with the nRF24L01 in a box (as shown in "fig. 4") which is a direct plug and play module that can be connected to any PC without installing the drivers as well as knowing the knowledge of arduino. There is a switch placed on the box which enables two modes of operation that includes mouse and gaming mode.

Fig. 5. Hardware implementation.

B. Operation Implementation

The whole ideology behind the project is to map the gestures of the wrist to achieve certain applications. Thus, this device deals with two modes of operations:

- Mouse mode and
- Gaming mode.

Fig. 6. Device in gaming and mouse mode.

Former includes implementation of cursor movement onto the screen which is mapped via wrist gestures (mouse mode).
Latter includes mapping of keyboard via wrist gestures; for example- 'W', 'A', 'S', 'D' key of a keyboard are used for car movement in a game (gaming mode).

VI. MODIFIED LIBRARY AND HARDWARE PLACEMNET

a) As the program we wrote, the libraries of mouse and keyboard were not supporting the device and hence we modified the libraries.
b) Hardware placement was the most critical part as we didn't want it look bulky and non-user friendly hence we created as a glove which can be worn in one hand comfortably.

VII. CONCLUSION

Although the wrist sensor is functionally complete, aesthetically and play wise there is always scope for improvement and expansion as we can always add more features such as quad copters, controlling robotic arms, humanoid, small trolleys and support for virtual reality.
This prototype has given us a clear idea of how a mouse and keyboard can be embedded in a single sensor and has cultivated in us the qualities and skills needed to be a success in the professional and gaming industries within a cost effectiveness taken in to consideration. The fully functional device is made within a price of Rs.1500/- which quite low as compare with the high-end devices priced at the present market. If the device is manufactured in bulk, then its price can be further reduced.

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