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Smart Remote Control: Universal Remote Control using RF Sensors and GSM Technology

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Abstract - The proposed paper introduces a smart remote control capable of activating and controlling most of the electronic devices itself such as TV, Fan, AC, Lights, etc. The universal remote control is a user friendly device that can be a replacement over many other remote controls of various electronic devices such as TV, audio/video player, AC etc. It can also handle various devices that don't come with remote control like for example lights and fan. These remote controls comes with a big manual explaining the remote control and it's functioning but it is very difficult to learn how to use the remote control and actually use them as there are so many of these are present. Hence the smart remote control will replace all of them and function as same as they does.

Keywords- **Smart Remote Control (SRC), MEMS accelerometer, RF sensor, GSM module.**

1. Introduction

The number of electronic devices is increasing day by day. As the technology is developing these devices are coming with more and more functions hence as functionality is increasing the difficulty to use these devices is also increasing. As a result the users find it difficult to handle various electronic devices with separate remote controls. To reduce the user efforts of learning various remote controls we are introducing a smart remote control which can handle various household electronic devices itself without having a complex methodology despite some hand gestures. The smart remote control is capable of activating as well as controlling the devices with simple hand gestures. The main component of the smart remote control is a MEMS accelerometer. It is a micro-electro-mechanical system which is capable of correctly measuring any acceleration, motion, speed, vibration or tilt. In response to any unique movement, it produces unique Frequency. The second important component is RF sensors including transmitter and receiver. The radio frequency sensors are capable of sending the signals to 20-25 meters and also penetrating physical solid objects. To increase the operating range of the device we are adding GSM technology to it so that the operating range should increase.

2. Previous Work

In the past few years the study on URC has become a topic of interest of many peoples. Hence there is sufficient work done on the universal remote control. The most advanced URT was produced by Ardiansyah, Deokjai Choi, Youngchul Kim, Ali Fahmi PN, Prayoga Budhi, Jongmin Song [1] in the year 2013 called "3D-to-2D Projection Algorithm for Remote Control using Smartphone". In this system the Smartphone itself works as URC. The Smartphone shows all the devices it can handle on its display. To activate any device the user just had to touch device name on Smartphone display and after touching that name, whole menu of that particular device is displayed on the Smartphone screen. To activate the device the user had to touch ON label likewise to deactivate OFF label. Another attempt to make the URC was made by Ting-Fang Chueh and Yong-Yi FanJiang, [2] in the year 2012 called the "Smartphone based universal remote control". Successive attempts were made to produce URC in year past years one of them was made by Bonhyun Koo, Taewon Ahn, JungSik In, Youngsuk Park, Taeshik Shon, Juhi Ranjan, Hiren Shah, Sanika Joshi, Brijesh Chokhra and Prabhat Ranjan called "R-URC: RF4CE-based Universal Remote Control Framework using Smartphone"[3-5] in year 2010. These

devices were very good devices making things easy for the user but the Smartphone based URC also has some disadvantages such as it is very expensive as we see any Smartphone in market comes at last for Rs 20000-30000 so for middle class people it was out of their budget. To overcome this drawback we introduce new URC at very low cost. The Smartphone based URT was also very delicate in terms even if it falls on the floor it's display gets damaged and repairing it is very costly as it itself very costly. Hence to overcome this drawback we are introducing a new URC with very robust structure immune to any physical damage.

URC based on wrist watch type device was made by Dong-Woo Lee, Jeong-Mook Lim, John Sunwoo, Il-Yeon Cho and Cheol-Hoon Lee[6] in year 2009. They introduced Universal remote control based on IR sensors capable of handling various electronic devices at home. It was a wrist-watch type device. The basic of this URC is to capture the unique hand motions and use it to activate the particular device. After activating the device a virtual menu of that device is created and the device is controlled with that virtual menu. It was a useful device but it had various drawbacks such as it was having very short range of 6-8 meters and it was unable to penetrate the physical solid objects. smart remote control these two disadvantages are eliminated by using RF sensors and GSM module. The second attempt to produce the URC was done by. In this system the Smartphone itself works as URC.

3. Implementation

The implementation process starts with the MEMS accelerometer which is most important part of the system. Why measure acceleration?

- Acceleration is a physical characteristic of a system.
- The measurement of acceleration is used as an input into some types of control systems.
- The control systems use the measured acceleration to correct for changing dynamic conditions.

Accelerometer is an electromechanical device which measures acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic - caused by moving or vibrating the accelerometer. Accelerometer usually detects acceleration up to 3 axes. The Free-scale accelerometer is a surface-micro machined integrated-circuit accelerometer. The device consists of two surface micro machined capacitive sensing cells (g-cell) and a signal conditioning ASIC contained in a single integrated circuit package. The accelerometer we are using is IC mma7660 (fig shown below). Acceleration of the sensor forces displacement of the proof mass, and the displacement is sensed using differential capacitors. The accelerometer dies were packaged in leadless chip carriers (LCCs), and the LCCs were arranged in a three-axis configuration. A circuit was constructed to convert the differential capacitance signal into an analog signal and then into a digital signal before being read into a computer. The data acquisition program allows real-time analysis of the acceleration data, as well as storage of the data for more sophisticated subsequent analysis.

The g-cell is a mechanical structure formed from semiconductor materials (polysilicon) using semiconductor processes (masking and etching). It can be modelled as a set of beams attached to a movable central mass that move between fixed beams. The movable beams can be deflected from their rest position by subjecting the system to acceleration.

Fig.1. Accelerometer mma 7660

As the beams attached to the central mass move, the distance from them to the fixed beams on one side will increase by the same amount that the distance to the fixed beams on the other side decreases. The change in distance is a measure of acceleration.

Following figure shows another type of accelerometer

Fig 2: MEMS Accelerometer

Acquiring measurements from the module is simplified through a synchronous serial interface. Single and multi-axis models are available to detect magnitude and direction of the acceleration as a vector quantity. Single axis measures the force in any of the three directions namely X, Y or Z. Based on the sensitivity, accuracy and supply voltage, acceleration to voltage conversion is performed. The Electronic module comprises a homework board that has an 8-bit flash based Programmable Interface Controller, an EEPROM with a fixed program, a Voltage regulator and reset circuitry to control the operation of the Assist system. The Mechanical module consists of a user interface and computer with software to run the program for the motor. The program is in the form of high level commands. The Indexer is capable of generating step pulses and direction signals for the Driver. The Driver converts the indexer command signals into the power necessary to energize the motor windings. The Driver receives low-level signals from the indexer or control system and converts them into electrical (step) pulses to run the motor. Speed and torque performance of the step motor is based on the flow of current from the Driver to the motor winding.

The g-cell beams form two back-to-back capacitors fig. As the center beam moves with acceleration, the distance between the beams changes and each capacitor's value will change, ($C = A\varepsilon/D$). Where A is the area of the beam, ε is the dielectric constant, and D is the distance between the beams. Accelerometers are available in different sensitivities. The sensitivity of an accelerometer is measured in terms of g (gravitational acceleration i.e 9.8 m/s^2). So accelerometers are available in 1g, 2g, 3g etc sensitivities. The sensitivity of an accelerometer can be varied accordingly keeping in the application i.e., if more sensitivity is desired with simple coding we can achieve it. Accelerometers are available in different sensitivities. The sensitivity of an accelerometer is measured in terms of g (gravitational acceleration i.e 9.8 m/s^2). So accelerometers are available in 1g, 2g, 3g etc sensitivities. The sensitivity of the of an accelerometer can be varied accordingly keeping in the application i.e if more sensitivity is desired with simple coding we can achieve it

The other component is the RF sensors. The circuit diagram shows a simple 5 channel radio remote control circuit basedon IC tx-2b and rx-2b from silan semiconductors. tx-2b / rx-2b is a remote encoder decoder pair that can be used for remote control applications. tx-2b / rx-2b has five channels, wide operating voltage range (from 1.5v to 5v), low stand by current (around 10ua), low operating current(2ma).It also has auto power off function and requires few external components. The tx-2b / rx-2b was originally designed for remote toy car applications, but they can be used for any kind of remote switching applications. The figure shows the tx-2b and rx-2b kits. The CC2500 provides another type of RF transmitter Receiver pair. is a low-cost 2.4 GHz transceiver designed for very low-power wireless applications. The circuit is intended for the 2400- 2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band. The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 500 k-Baud. CC2500 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio. The main operating parameters and the 64-byte transmit/receive FIFOs of CC2500 can be controlled via an SPI interface. In a typical system, the CC2500 will be used together with a microcontroller and a few additional passive components.

Features of CC2500:

1. High sensitivity (–104 dBm at 2.4 kBaud, 1% packet error rate).
2. Low current consumption (13.3 mA in RX, 250 kBaud, input well above sensitivity limit).
3. Programmable output power up to +1 dBm.
4. Excellent receiver selectivity and blocking performance.
5. Programmable data rate from 1.2 to 500 k-Baud.
6. Frequency range: 2400 – 2483.5 MHz.

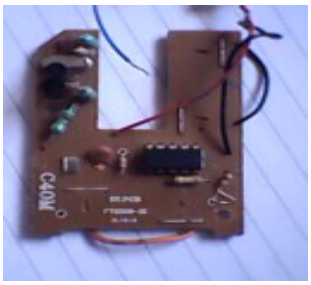

Fig 3: TX-2B RF Transmitter

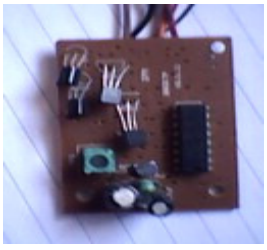

Fig 4: RX-2B RF Receiver

GSM module is another part of the system which is added to increase the operating range of the system.

4. Working

The MEMS accelerometer is fitted inside the Smart Remote Control catches perfectly any hand movement of the user and produces a specific frequency in response to it. This specific frequency is then sent to the RF transmitter. The figure 5 shows many hand movements that user can make. Fig 6 shows the accelerometer operation. it.

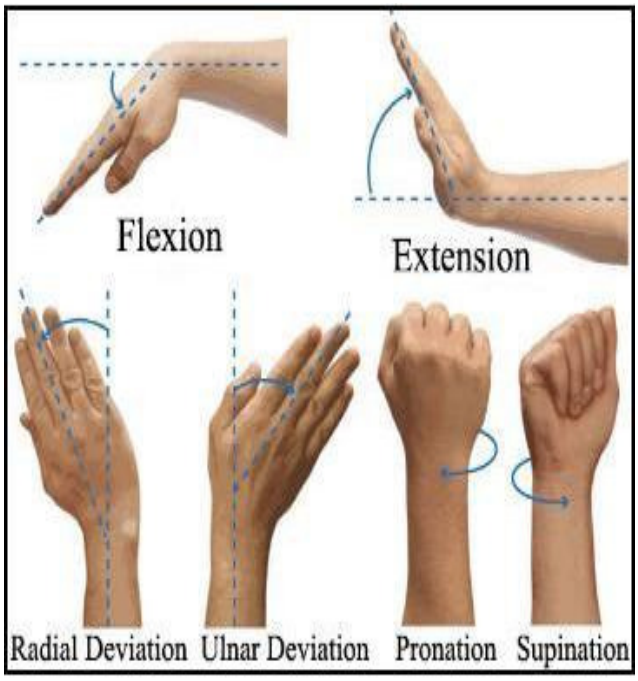

Fig 5. Hand motions

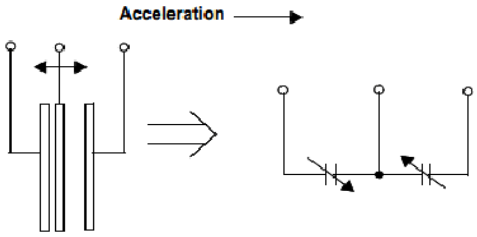

Fig 6. Accelerometer Operation

The RF transmitter receives the frequency produced by the accelerometer and sends it to the RF receiver in the control unit. The RF receiver receives the frequency and the control unit then activates the specific electronic device. After activating the device it is controlled through some hand movements specially designed for that device. The GSM module is having two kits one with the actual remote control and one with the control unit. Whenever the off signal is sent from the user the GSM module at SRC sends that signal to the GSM module at control unit and through the RF transmitter and receiver it proceeded to the control unit and corresponding action. Following block diagram shows the complete working procedure of the system

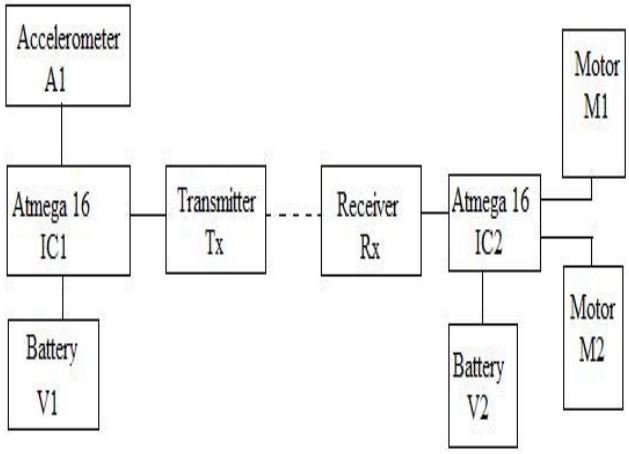

Fig 7: Block diagram of the system

5. Conclusion

We use various remote controls for various electronic devices. But it is very difficulte to use all of them without any trouble. Sometimes the buttons of these remots takes some time to work which adds to the fristration of user for example to increase the volume of TV the usere has to press the volume key number of times. To provide a solution over these problems and reduce the difficulty to use number of remote controls for several devices we introduce a new way to handle the electronic devices with a single remote control called Smart Remote Control. The Smart Remote Control provides an efficient way to overcome these problems and an attreactive alternative over the number of remote controls.

In this paper we introduce a Smart Remote Control capable of controlling most of the electronic devices at home with very simple user hand movements having an attractive method of using it. It can handle the electronic devices with simple hand motions. The SRC can activate and control of the electronic devices specific set of

movements which are not difficult to master. Hence the SRC not only reduces efforts of handling various remote controls but also provides an attractive interface to control the electronic devices.

6. Future Work

In The future we will try to handle computer mouse with the SRC and make it work for Microsoft office. The operations like cut, copy, paste, etc will be done through SRC. Also we will try to apply this concept to handle number of machines present at the workstations. Along with it we will also try to handle even more devices and add more functionality to it. Make it more user friendly, lighter for more usability.

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