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Human Body Motion Triggered Lamp Indicator as an Alert with PIR Sensor for the Hearing-Impaired

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***Abstract*—The need to enhance the living standard and the security consciousness of the deaf in the community can not be over emphasized, hence, the this paper presents human body motion triggered lamp with PIR sensor forthe purpose of recognizing human body motion and create awareness by switching on a lamp in the room of the hearing-impaired (user). This becomes necessary as nowadays systems are too dependent to the community. This project will be able to inform the owner of the house through alert lamp when a superfluous visitor or thief enters the range of the sensor. The system design is in three main stages: the perception (through PIR sensor), processing (with programmed microcontroller) and action (illumination alert). This system is design to only detect only (or part of human) body motion. This project will be able to inform the user through lightening on a lamp alert when an unwanted visitor or thief enters the range of the sensor.**

Keywords—Human body; Motion; sensor; Microcontroller; Lamp; deaf; Security;

I. INTRODUCTION

The deaf, as member of the community, needs to be catered for in the advanced technology especially in a high level theft environment, the need to improve on hearing–impaired security system can not be over emphasized. It is much safer to have a system that monitors and alert the device owner. Motion detection is the action of sensing physical movement in a given area[1]. Motion can be detected by measuring change in speed or vector of an object in the field of view. This can be achieved either by mechanical devices that physically interact with the field or by electronic devices that quantifies and measures changes in the given environment. There are two device of motion detection which is the mechanical device and the other one is electronic device. In the mechanical device, a tripwire is a simple form of motion detection. If a moving objects steps into the tripwire's field of view then a simple lighting device like bells may alert the user[2]. Mechanical motion detection devices can be simple to implement, but at the same time, it can be defeated easily by interrupting the devices' mechanics like "cutting the wire". While in electronic device, the electronic motion sensing such as motion detectors, can prevent such mechanical intervention. Since motion detectors are so flexible and have so many uses, it offers feelings of protection and security for the average homeowner as well as commercial organizations. Infrared sensors are widely known in the arts of intrusion detection and in fire or smoke detection. It is a device that often used in automatic light switches and security systems to turn on a light or to activate some other form of lamp or warning indicator when a person enters a monitored area.

The infrared sensors have basically two forms: active and passive. An active infrared detector includes a radiation source and an infrared sensor which is sensitive to interruptions in the radiation sensed from the source. Besides, it is insensitivity to mechanical and acoustic noise, which presents substantial problems in the passive infrared (PIR) sensors[2]. Low production cost is another advantage of these active infrared detectors. Passive infrared motion detection detects heat energy radiated or emitted by an object, such as a body of a person, moving across a field of view of a heat sensor of the motion detection system. It is generally use an optical collection system and multiple sensing elements of alternating polarity to create a detection pattern in the volume of interest.

In an ultrasonic motion detector, there are two transducers; one emits an ultrasonic wave and the other picks up reflections from the different objects in the area. The reflected waves arrive at the receiver in constant phase if none of the objects in the area are moving. If something moves, the received signal is shifted in phase. A phase comparator detects the shifted phase and sends a triggering pulse to the lightening indicator, the bulb. The purpose of using the infrared as a sensor to detect motion for this project is surely on the advantage offers by the sensor. Its capability on detecting motion with a simple design at lowest cost is needed to build an effective house security system based on motion detection[3].

II. TECHNOLOGY USED

The system design is in three main stages: the motion discernment (through PIR sensor), processing (with programmed microcontroller) and action (illumination alert). This system is design to only detect only (or part of human) body motion. This project will be able to inform the user through lightening on a lamp alert when an unwanted visitor or thief enters the range of the sensor.

A. The Motion Discernment (Detector) Circuit

A motion detector is contains a motion sensor and is either incorporated with or connected to other devices that alert the user of the pre-sense of body motion. An

electronic motion detector contains a motion sensor that transforms the detection of motion into an electric signal. The electric signal can be connected to a burglar with lamp system which is used to alert the home owner or security service after it detects motion.

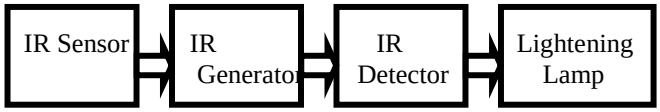

Fig. 2.1. Block Diagram for Human Body Motion Triggered Lamp indicator as an Alert with PIR Sensor for the Hearing-impaired.

In the Passive system each sensor consists of two housings. The first housing contains an infrared-emitting diode and an infrared-sensitive phototransistor as the infrared detector. The other housing contains an infrared reflector to reflect the infrared signal. When positioned in front of an entrance to a protected area, the two housings establish an invisible beam.

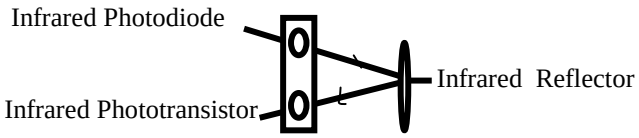

Fig. 2.2. Passive infrared Motion detector for a Security System.

The infrared motion detector circuit is based on two basic principle of passive infrared motion detector which is the infrared transmitter and infrared receiver as shown in Figure 3.4.

Infrared transmitter

For the infrared transmitter which is also known as emitter circuit, it is on a basic design of timer 555 astable operation. The output of timer is connected to the infrared transmitter is used to produce pulse using an astable timer circuit. In astable circuit operation, pulse will continually generated until the power supplied through the circuit is removed. The astable circuit produces a continuous train of pulses at any frequency required[2]. This means that the 555 timer can operate repeatedly; it will switch 'on' and 'off' continually to generate data for the infrared transmission.

Infrared receiver

The infrared receiver which is also known as infrared detector receives the data transmitted by the infrared transmitter circuit[1,2]. This infrared detector can be directly connected into the controller circuit to produce logic high '1' or low '0' from the output terminal thus activate or deactivate the controller system operation. The range of infrared detector components according to datasheet stated that the infrared detector can fully operates on detecting the infrared signal of 38 to 45 kHz.

B. *The Microcontroller circuit*

The controller systems that use to control the motion detector system and other electronic devices are the microcontroller PIC16F1508 – expended mode. In expended mode configuration, external ROM and RAM are used to add the data memory to be more than internal memory provided by the Intel manufacture. The purpose of using an expended mode for the project is to expend more data available on developing and designing an excellent operation of the security system.

III. CIRCUIT DESIGN

A. *Block Diagram of the System*

Fig.3.1 resembles a simple block diagram of the system.

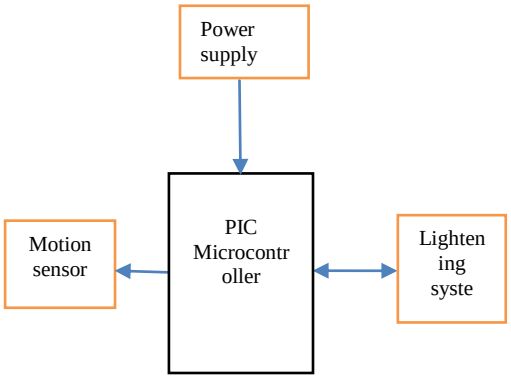

Fig. 3.1. Block diagram of Human Body Motion Triggered Lamp Indicator as
an Alert with PIR Sensor for the Hearing-impaired.

Motion Sensor

The motion sensor is pyroelectric infrared transducer performs the function of transmission and receiving the signals. The signals which pass through the transducer are the infrared heat signals. It has the Fresnel lens which performs the function of converging the infrared signals and passing it to the

PIC Microcontroller

This is the heart of the system wherein central processing of data takes place. PIC microcontroller collects the data or information from various sensors and compares it with appropriate prescribed limits. By receiving the sensor signals, it takes the corresponding course of action by sending commands to the output devices.

Power supply

The power supply supplies electrical energy to the system.

Lamp indicator

This makes use of Lamp as output lighting device that that switches on when any human body motion is detected within the coverage range of the sensor.

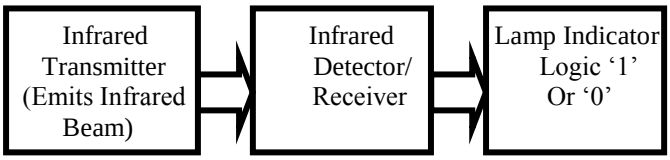

Fig. 2.3. Block diagram of infrared transmitter/ receiver.

B. *Description of the Circuit Components*

i. *Microcontroller (IC2)*

This is the CPU (central processing unit) of our project. The various functions of microcontroller, Figure 3.3, are like: Reading the digital input from infrared receiver and find out if person is within the house, sending this data to lamp and LED so that the person operating this project should detect the presence of any person within the building.

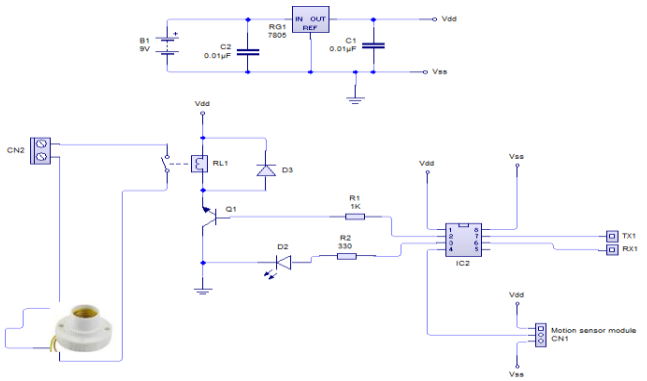

Fig. 3.2. Simplified circuit diagram of human body motion triggered lamp indicator as an alert with pir sensor for the hearing-impaired.

Fig. 3.3. Micro-controller.

ii. Motion Sensor

An intruder who moves through the beam breaks a circuit in the receiver, triggering an alarm. Active infrared motion detectors are a more advanced version of electric-eye motion detectors, which use a photoelectric cell to detect an interruption of a beam of light. Active infrared systems use invisible infrared energy, so an intruder is less likely to discover or avoid the system [2].

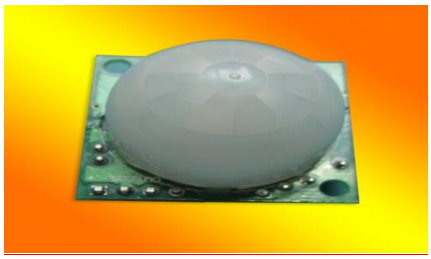

Fig. 3.4: Passive Infrared Motion Sensor Module Diagram.

Motion sensors are used in a motion detector which is a device that contains a physical mechanism or electronic sensor that quantifies motion that can be either integrated with or connected to other devices that alert the user of the presence of a moving object within the field of view. They form a vital component of comprehensive security systems, for both homes and businesses. Motion sensors cannot detect still objects.

iii. Light Emitting Diode (LED)

Light emitting diode is a two-lead semiconductor light source. It is a basic pn-junction diode, which emits light when

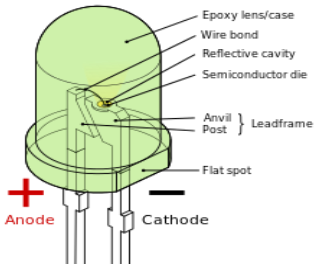

Fig. 3.5. Light Emitting Diode.

activated. [4] When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energies in the form of photons. An LED is often small in area(less than $1mm^2$) and integrated optical components may be used to shape its radiation pattern [5].

iv. Power supply

The power supply supplies electrical energy to the system.

v. Relay

The relay acts as a mechanical switch to the SECURITY LIGHT either to ON or OFF. The relay driver is used to

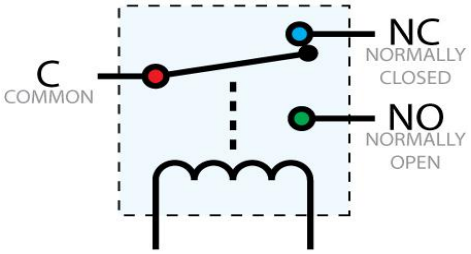

Fig. 3.6. Relay Switch Connection.

isolate both the controlling and the controlled device. The relay is an electromagnetic device, which consists of solenoid, moving contacts (switch) and restoring spring and consumes comparatively large amount of power. Hence the relay is used to switch the electrical supply to the appliances. From the Figure when we connect the rated voltage across the coil the back emf opposes the current flow but after the short time the supplied voltage will overcome the back emf and the current flow through the coil increase. When the current is equal to the activating current of relay the core is magnetized and it attracts the moving contacts. Now the moving contact leaves from its initial position denoted "(N/C)" normally closed terminal which is a fixed terminal. The common contact or moving contact establishes the connection with a new terminal which is indicated as a normally open terminal "(N/O)".

vi. Voltage Regulator 7805

RG1 7805 is voltage regulator. It brings the input voltage down to 5V that the microcontroller needed.

vii Light Indicator (the Bulb/Lamp)

It's a device that produces light from electricity; it is used in place of buzzer, unlike in the previous work [7], in this project. Whenever a person is detected, it shines on the person to create awareness of being noticed since the deaf can see the illumination.

Fig. 3.7. Bulb.

viii. Filter Capacitor (Non-polarized)

In the project, the filter capacitor is the electronic component that removes voltage or signal spikes in an electronic circuit. C1 and C2 are noise filter capacitor for the microcontroller

viii. 9V Battery

An electric battery is a device consisting of one or more electrochemical cells that converts stored chemical energy into electrical energy. In the project, we made use of a 9v battery for powering the LED.

ix. Transistor, Q1

In the project, the transistor acts as a driver for the relay

x. Resistor:

R1 and R2 are current limiter to transistor Q1 and LED respectively.

C. Software Development for the System

The PIC software algorithm is as follows:

ALGORITHM

1. Start
2. Microcontroller configuration
   a. PORTA.0 to PIR(sensor)
   b. PORTA.1 to red Led
   c. PORTA.2 to green led
   d. Porta.4 to Lamp
3. Initial configuration
   a. Flash red led, Green led
   b. Buzz for some seconds
   c. Goto disable state and on the green led
4. Endless loop
5. If motion is detected and in active state
   a. Red led is on
   b. Buzz
6. If motion is not detected and in active state
   a. Red led on
   b. Lamp off
7. If motion is detected or not detected and in disable state
   a.Green light on
   b.Lamp off
8. End endless loop
9. End

IV. CONSTRUCTION

While constructing a microcontroller based system, it basically involve design and validation, veroboard implementation, testing and result and packaging.

A. Design and Validation

It has now become possible to program microcontrollers; gone are the days when circuits are built around chips, now we can build chips around circuits. PIC12F1840, 8 bit, microcontroller was used for this project. In order for the microcontroller to be able to perform its function in this project, it will require writing of a code of program onto it. This code will allow the PIC to do the required job. The code of program could be written in High Level Language (HLLs) or Assembler language (Low Level Language). HLLs compilers for PIC microcontroller include: MikroC, PicBasic, PICC18 etc. The assembly language for PIC microcontroller is MPLAB from MICROCHIP. HLLs was used over assembly language based.

B. Veroboard Implementation

After proper verification, the design was transferred to a veroboard for permanent construction. The components were arranged and soldered on the veroboard such that each component can easily be identified. Before proper soldering, component layout plan was drawn paying particular attention to minimizing the distances involved between point to be connected and the prevention of the overcrowding.

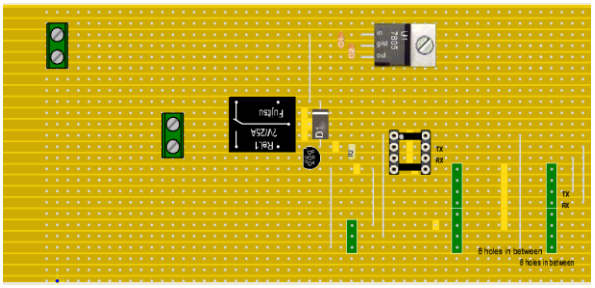

Fig. 4.1: Vero board Layout of the System

C. Testing and Result

It is of paramount importance to establish a highly efficient testing technique in other to minimize cost. The testing instrument used for examining logical signal, testing and troubleshooting application in the course of this project were: digital multimeter, logic probe and oscilloscope. Testing involves troubleshooting the hardware system to detect, isolate and correct internal or external fault such as malfunction in the internal circuitry, input or output shorted or V_{cc} input or output open circuited, short circuit between two pins broken wire, poor of dry connection, bent or broken pins, or an IC and faulty ICs socket.

The hardware system was properly tested because the software cannot work without the proper functioning of the hardware. The testing of the entire circuit was carried out in stages:

- Each of the components was first tested using the multimeter in order to check for their state of performance and accurate values.
- In the connection, each component on the veroboard was then tested. This was done in other to carry out the continuity, which is meant for proper connection of the circuit and to detect any wrong connection.
- The sensory unit circuitry was tested to ascertain the degree of sensitivity.

D. Packaging

After proper testing was conducted, the packaging of the design into a model and casing was considered. The connecting wires were properly connected and well insulated; also the wires were well packed and bounded together.

V. APPLICATIONS

A. Security Use

This project has its main application in security system. This project can be used in home domestic security system. It can be used in our house for theft detection at night time [6]. With the use of this system we can save the life of person inside home / industry, since thief causes life threat and properties.

B. Industrial Use

Various parameters monitored in this project like theft detection and are also applicable for industrial purpose as well. So this system can also be used in industries to trigger some automation system.

C. Commercial Use

We can use this project in shops to alert the attendant as well as other business organizations, since it has a sensor detector to detect any misconduct of persons.

D. Farm Monitoring and Animal Prevention use

It may chase wild animal away to avoid crop destruction with its sudden illumination at dark night.

VI. FUTURE IMPROVEMENTS

The future implications of the project are very great considering the amount of time and resources it saves.

A. GSM Module

The project can be implemented in other projects of greater level by incorporating it with GSM module such that after detection it can send a text message to the owner.

B. Camera Module

This project can be modified in order to send a more detail of the scene image to the watchman or security agents for further action if the need be.

C. Audio-Visual Scene Stream Recorder

Likewise, this project work may be developed further to have audio-visual recorder back up that may be played for verification. The scene recorded might then be sent though e-mail instantaneously to any location in the world.

D. Password Protection

To improve more on the security task of the system, the project may be develop to have access PIN for retrieving of data.

E. Programmable GSM mobile Number

By advancing it further to allow easy activation and change of alert phone number with e-mail for data reception . The product can be easily commercialized.

VII. CONCLUSION

By developing a microcontroller based motion detective system with lamp indicator for the hearing-impaired, the security awareness or alertness has been improved upon, once the device is install at the watch target. A more effective and sensitive sensor is recommended for better performance. For example a sensor such as passive infrared PIR sensor that could detect contraband good in vehicle. The achievement of a full automation, a real time system may be employed and a biometric scanner that will provide a proper monitoring and security purposes.

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