Method Article

Design Microcontroller based intruder lighting system (DMBILS)

Abstract

The microcontroller based intruder lighting system is an intelligent system that applies automated lighting system in homes, offices, industries, military zones etc. The research will feature design microcontroller based intruder lighting system that will activate light in environment in the presence of an intruder and inform the user about the coordinate position of the intruder.

The microcontroller AT89C51 and other electronic designs were employed to actualise mission stated above. The interfacing layer will make use of bi-directional communication. The sensors regards as input device and (Light Dependent Resistor (LEDS)) will receive the signal when the intruder obstruct signal path while the control program will translate the received signal from the sensors to useful information and activate lighting system and camera. The camera will capture image of intruder and safe to external memory. The design is to achieve energy-saving techniques and increase security strength of target environment.

Keywords: Intruder, Light dependent resistor, bi-directional communication, control program

Introduction

There are various research works on intruder systems on difference technology [1]. This design of microcontroller based intruder system is based on the simple Boolean logic concept that a sensor's switch contacts can be either open or closed [1].

The need to secure home, industries and other related properties has been a major priority of our target, since then, an aggressive development of technology in the area of security has exponentially been driven to today's trend.

A system cannot have high assurance if it has poor security and requirements in its design. For maximum assurance, systems will logically include security protocol requirement, as well as availability, reliability and robustness requirements to satisfy prototype system design [2].

The intrusion techniques required logistic person workflow in the environment where intelligent device is planted to measure Security Bridge or tendency of activating nearby light in a matter of obstruction. Recently, it has become one of the most interesting aspects of individual, national and even international concern. There are three procedures to initiate a home intruder system before integrating any technological component: (1) Install exterior lights and add either a timer or a motion detector device (2) Build security at all exterior doors and windows with strong locks (3) Trim and cut down trees that may cause obstruction especially around windows and doors. Many home intruder system tasks are easy and simple projects to install which can offer paramount security [3].

Looking at trends of technologies, there are different kinds of properties invader systems which are based on dynamic system protocols, for which the basic types of components are;

i. **Wireless Security Alarms** A wireless security system that offers user broad coverage. This suits a home intruder system that will stop intruders before gaining entrance and summon for help immediately to ensure home protection.

ii. **Micro computer based security system**

This system senses the presence of an intruder and alerts the user of the obstruction detected. It also displays the position of the intruder on a screen.

iii. **Motion Sensor Lights**

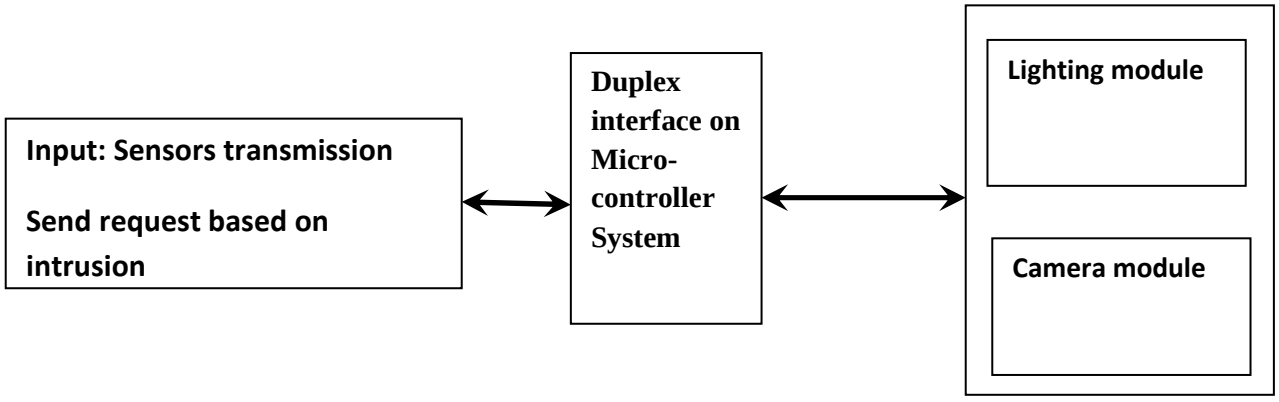
Motion sensor lights system make intruders react like a deer with headlights. It is difficult to break into a home or an office when there is a spotlight shining down right on user.

iv. Access Control Gates: This technology makes it hard for the intruder even to penetrate property, let alone into an office or a house, by surrounding environment with a high fence and installing an access control gate. An access control gate gives specific points of entry and exit onto user properties, and this can be monitored from inside [4]. A gate allows user, like family, co-worker and friends to enter and exit, but says "NO!" to intruders on restriction. A home intruder lighting system saves energy and keeps criminals further away from private or public properties.

The MBILS Device Framework

Microcontroller based Intruder lighting system (DMBILS) device is an evolutionary interface module that renders full duplex communication using microcontroller device. This will be described using block segments as it's interfaced on framework.

Figure 1: An overview of the internals of a DMBILS network.



An Overview of DMBILS Components

From the figure 1 above, the microcontroller operate the bi-directional mode as seen at the centre of design, receiving the input from intelligent sensor as well as the output from the other peripheral components (camera module and light module). The block diagrams consist of three stages, which are:

Sensor Module

The sensor module consists of the touch sensor, the light detector and the darkness detector. Each of these alarm sensing units makes up the different type of intruder detection system incorporated in this design.

The input transducers (sensors) vary their resistance and in most cases, voltage divider is used to convert this to a varying voltage for activation. The voltage signal in this design feeds as an input into a NPN (C945) transistor switch [5].

Selection of resistor value

The output voltage depends on resistor (R) values. Using a ohmmeter to calculate the minimum and the maximum values of the sensor's (LDR) resistances (R_{min}*R_{max}):

In this context: R_{min} = 1.50Kohm and R_{max} = 560kohm

Which gives $R = \sqrt{(Rmin*Rmax)}$ …… Equation (1)

Since the MBILS is capable of monitoring three different intruder from coordinate point, the above design was repeated three times to represent the input to the parallel port status pins.

The transistor input state

$$V_{out} = \frac{(V_{in} \times R_2)}{(R_1 + R_2)} \quad \text{…… Equation (2)}$$

Taking V_{in} = 5V, R_1 4.7 . 10^3 Ω and R_2 560. 10^3Ω

We Obtain V_{out} = 4.96V

This increases the base current that drives the transistor to saturation.

In bright lights we have R_1 4.7 . 10^3 Ω and R_2 9.5. 10^3Ω

So V_{out} = 0.01V

Microcontroller (AT89C51) duplex mode:

The specification for this design is AT89C51, an integrated circuit programmed with an universal programmer to receive input signals and relating it to other interfaced sub-module attached to it for its corresponding signals output [6].

Figure 2 showing Pin description of 8051/AT89C51 microcontroller

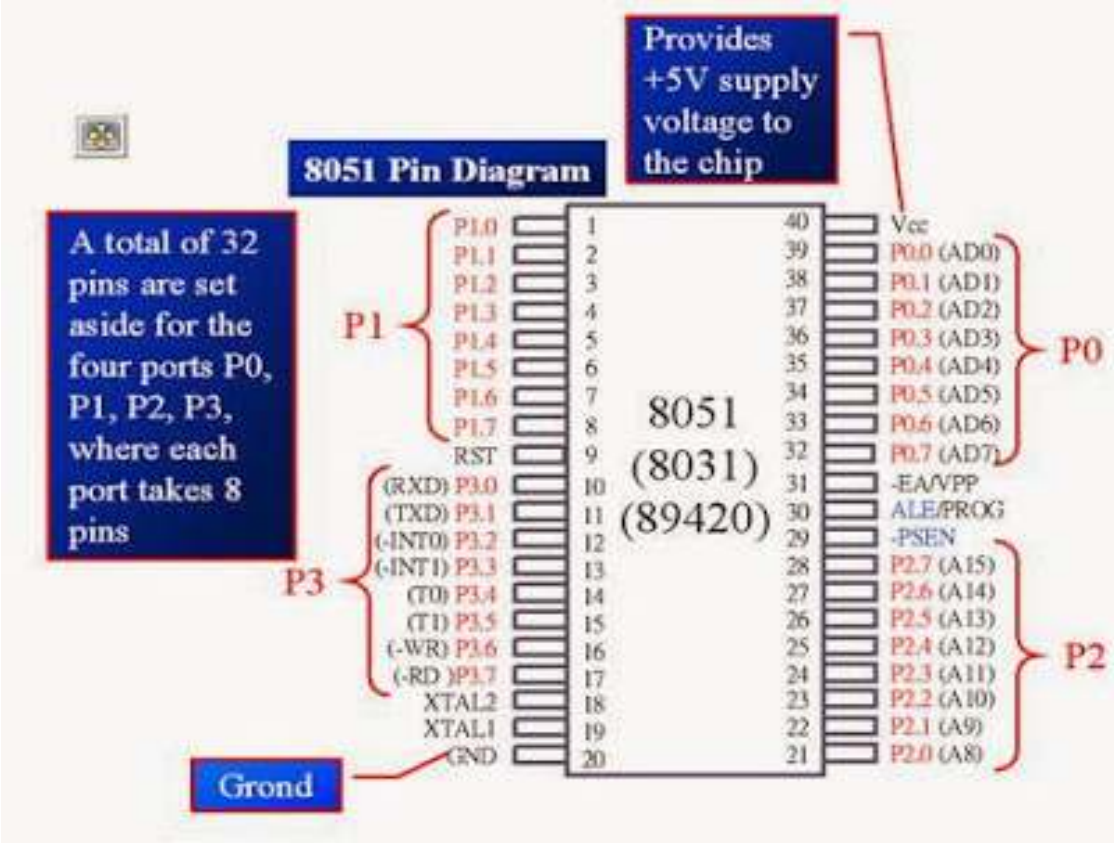
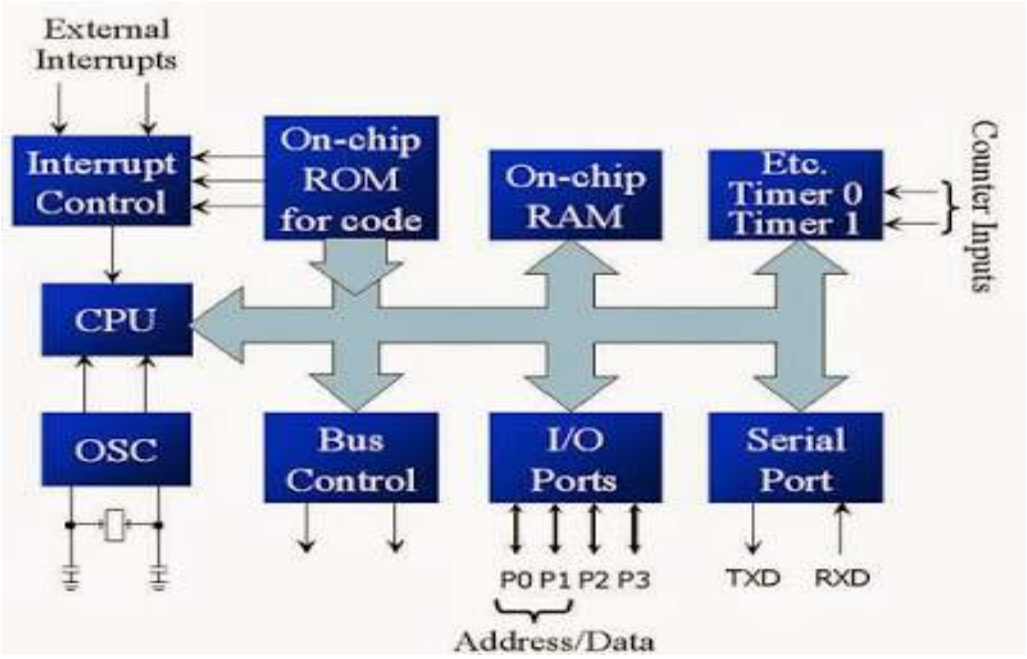


Figure 3 shows the internal registers of 8051/AT89C51 microcontroller



The Serial ports interrupt:

The 8051 family used in MBILS design is characterized with Serial Control (SCON). This can be configure data bit (address bit) and baud rate by write an SFR to write 'X' a value to serial port and set port mode to 1 or read SFR to read 'R' a value to serial port and set port mode to 1. The external as INT 1 are used by external CKT. It can be configured to either X' mission actionist or the external depending upon value at the units [7],[8].

MBILS cycle and crystal frequency

The microcontroller used in the design contains on-chip oscillator and also requires an external clock to run it. Most case a **quartz-crystal oscillator** is connected to inputs terminal XTAL1 (pin 19) and XTAL2 (pin 18). The quartz-crystal oscillator connected to XTAL1 and XTAL2 pins which required two capacitors of 33 pF value interface. One side of each capacitor is connected to the ground as shown in Figure 4

Figure 4: Crystal Oscillator

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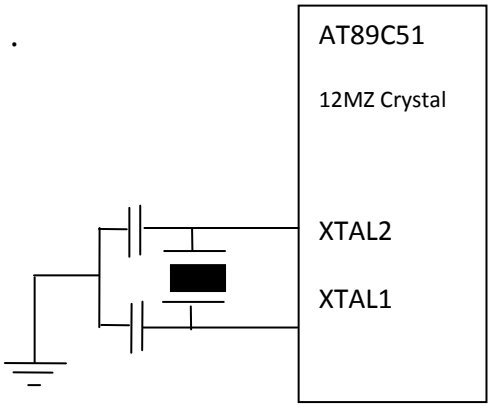


To determine BMONS cycle for compactable chips as follow. If XTAL = 11.0592MGZ

For (a) AT89C51 :- 1/11.05952MGZ = 90.42 nanoseconds (ns)

Therefore MBILS cycle = 12 X 90.42 ns = 1.085µs

1 X 90.42ns = 90.42ns

4 x 90.42ns = 361.68ns

It must be noted for this designs various speeds of the 8051 family. Speed refers to the maximum oscillator frequency connected to XTAL (Crystal Oscillator). For instance, a 12-MHz chip is required to be connected to a crystal with 12 MHz frequency or less. Likewise, a 24-MHz microcontroller requires a crystal frequency of no more than 24 MHz to function well. When the 8051 is connected to a crystal oscillator and is powered up, the frequency from the pin XTAL2 is clearly observed over oscilloscope for its performance.

For this foresight the experiment deduced that the number of machine cycles it takes to execute an instruction is not the same for the microcontroller AT89C51 and DS89C4xO digital signal processing chip as narrated in [7],[9].

Lighting Module

Relays are made up of electromagnet material and a set of contacts generally based on Single Pole Double Throw (SPDT) or Double Pole Double Throw (DPDT) switching method. It has 3 pins to perform functions

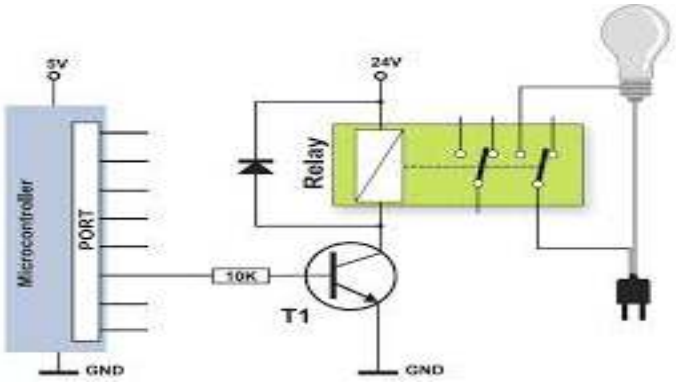
COM = Known as Common, always connected to NC pin; it is the moving part of the switch.

NC = Known as Normally Closed pin, (COM) is connected to this when the relay coil is off.

NO = Know as Normally Open pin, COM is connected to this when the relay coil is on.

The light device was connected to relay device interfaced with microcontroller with port 0 (P3.2). Relay will receive high and low signal from the microcontroller to enable to open and close output terminal. This interface module as shown in figure 5 indicate mono-directional communication with microcontroller AT89C51

Figure 5 Display Camera/Light Modules

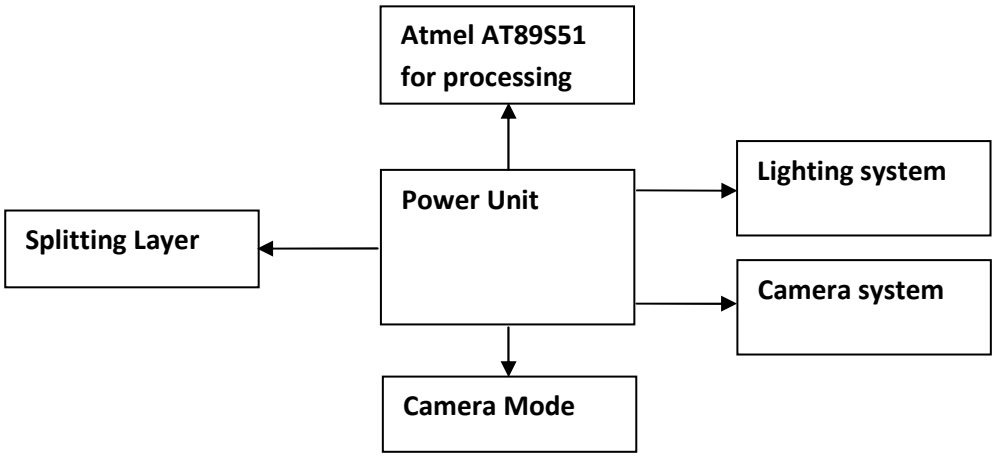


The camera display module is made up of intelligent 4.5 pixies to display the point of intrusion from camera view. The display unit is used in the design to make it easy for security operatives and users using the system to locate the intruder position.

Power Supply Transmission Model

The step-down transformer was used for transformation of AC signal, bridge rectifier diodes was used as rectification, capacitors used as filter by allowing AC components to pass by block DC component and lastly, a voltage regulator was used to regulate output to voltage to +5v [11].

Figure 6 shown Power Configuration to sub-systems



Benefit of DMBILS Device

The MBILS helps detect unauthorized entry onto a target environment. The system sends a signal to central processing and monitoring centre when activated. The processing and monitoring centre provide 24/7 service and will alert owner, security units and other authorities on the nature of invasion scene [10],[12].

DESIGN ANALYSIS

The design methods and then analysis employed in the design of the microcontroller based provided duplex communication between input and output [13]. These analysis are required to make the correct choice of component values for effective performance. The analysis is divided into modules namely

i. The power supply module

ii. The light detector module

iii. The darkness detector module

iv. The processor module

v. The camera module

Design of the Light Detector Module

The design of the light detector module was achieved using a Light Dependent Resistor (LDR) interfaced to an NE555 timer to detect the presence of light in the dark environment. When an intruder flashes a light device in the restricted zone, the LDR resistance decreases and the NE555 is triggered through pin 2 and then sends out an output through pin 3 to the microcontroller pin as a high signal [14].

The light detector detects an intruder either trying to open a door in a secured area kept in darkness; therefore, once light is detected, this will trigger or activate the camera to snap image at the scene and initialize video stream with support of activated lighting module to ensure clear image detection over active camera as (shown in figure 4).

Design of the Darkness Detector Module

The design and implementation of the darkness detector unit was achieved using a Light Dependent Resistor (LDR) interfaced to an NE555 timer to detect the absence of light. When an intruder obstructs a lighting point or casts a shadow to block light falling on the

sensor in the activated area, the camera will be activated and the screen displays the zone where the intrusion is coming from [14], [15].

Design of the Processor Module

The design of the processor unit was achieved using AT89C51 microcontroller. The processor unit takes care of taking the signals from the sensors and activating the camera to show the point of intrusion or enable lighting system for clear vision or illumination of the target facility [16]. Therefore makes it easy for the intruder to be caught. The Processor unit controls the overall function of the system since it takes the signals from the sensor inputs and determines the necessary action to take by showing the zone of intrusion points and also directing the authority in modality to apprehend the criminal by giving away the position of the criminal scene [17].

The Software Design Module

This program is written in c language and it contains the bearer's intension. The aim of this program is to control the sensors, camera and light device [18]. The software development was executed in the following phases;

i. Writing of the source code in C language.

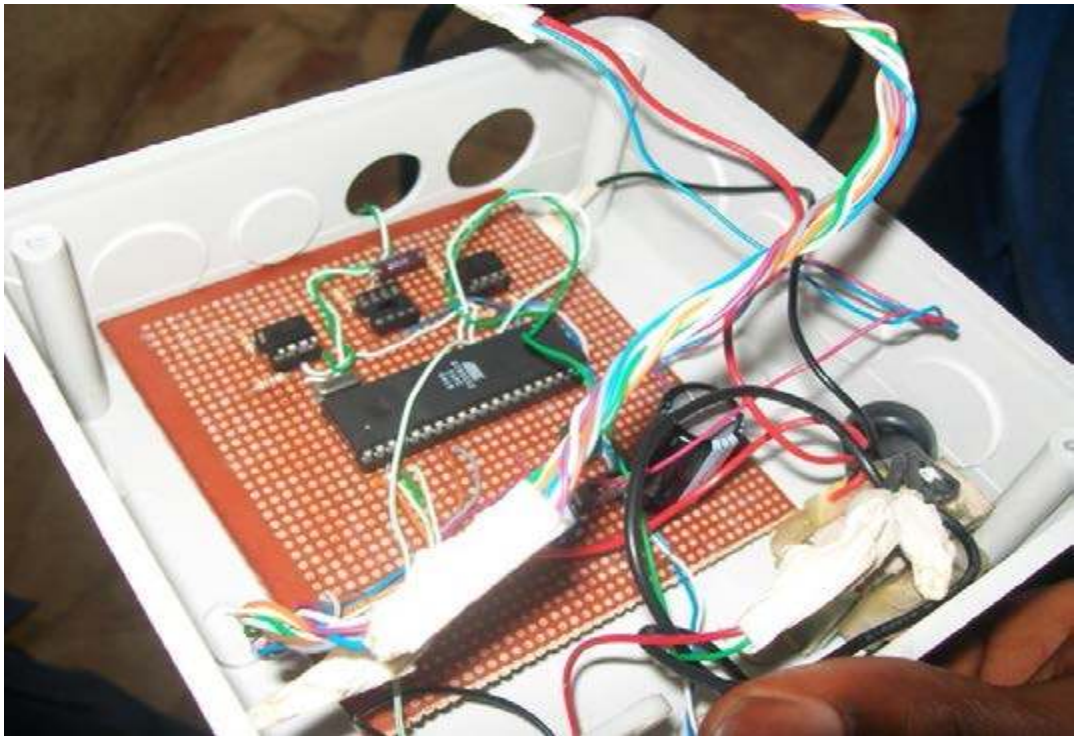
ii. Compiling the source code using Keil micro-vision compiler.

iii. Programming the microcontroller with the output hex file from the compiler using Unipro Universal programmer.

Discussion

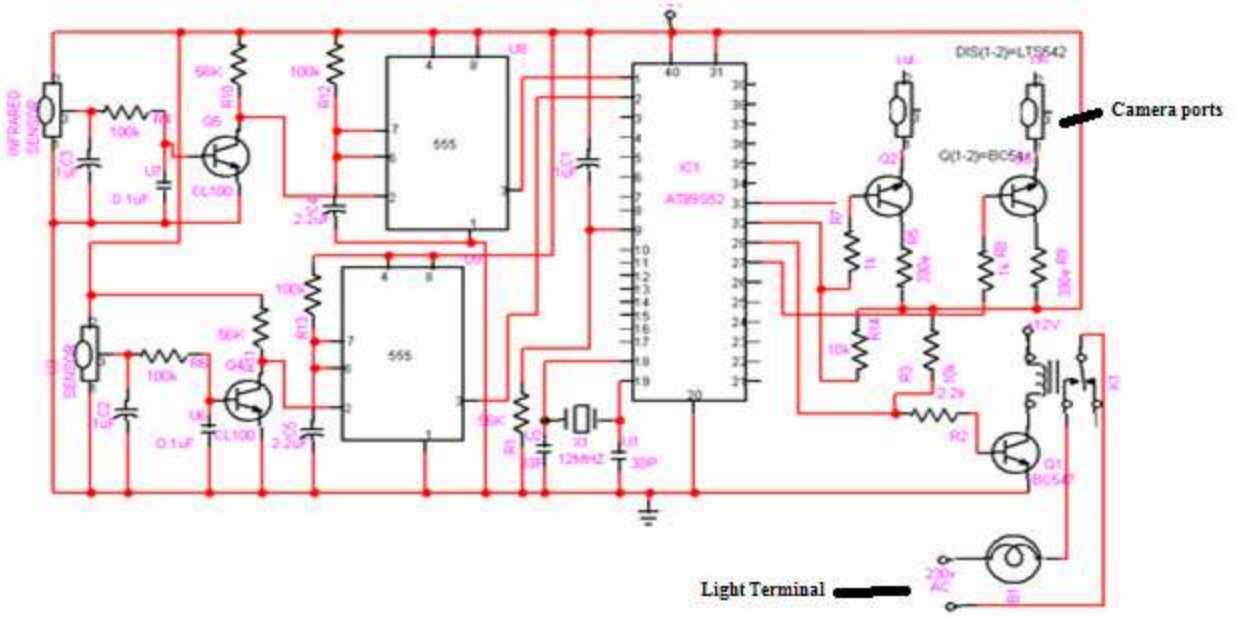
During the design and construction of this project, testing was carried out at different stages to determine if the results obtained at each stage met the desired output. Then the sub-system module was built and tested for durability, efficiency, and also to ascertain if there is need to modify this design. The system was first assembled using a breadboard. All components were properly inserted into the breadboard from whence some tests like (reliability, performance evaluation and service response test) were carried out at various stages.

Figure 7: Diagram above showing internal structure of sensors, camera and light device



In figure 6 above, the sensor is used as input signal while camera will depends on illumination of the environment to capture image of intruder and store in external memory to compensate alert signal at the security unit for further investigation. In other way round, this is efficient to safe energy usage because light system in environment where there is no passage of human or intruder will remain off till the system detect obstruction on sensors path.

Figure 7: **MBILS** ***Circuit Diagram***



The figure 7 is used to construct DMBILS device shown in figure 6 therefore further modifications can improve our design by improvising motion detector device with sensors.

Conclusion and Recommendation

MBILS devices are installed in buildings to protect human being and properties. When lighting and camera is triggered, a captured image from the camera is needed for investigation. Normally, the authority must set up investing panels to capture the intruder using security protocol at their disposal. On the other hand the device can serve as energy saving device for situation when light has to be used and customize energy-consumption patterns when necessary, using intrusion automation to activate light in the environment.

This project undergoes sequential experimental design and construction. These included power unit, controller unit, input and output which has gives room to use microcontroller to solve problems in workshop, houses, offices, etc. Further work is required in aspect of casing and portability.

Therefore, this research work has involved the use of both hardware and software to bring about the project entity. Going through the facility planning, flow process, design and software implementation the system had extensive prototype but there are multiple numbers of security systems which are available to protect life and properties likewise energy-saving devices for electrical and electronic systems. Future work is required to develop extension link for adaptive alert module and wireless network intrusion but this will having additional cost and resources for future upgrade using Atmel AVR ATmega16 microcontroller.

Reference

[1]. Ramesh bharadwaj (2003), DEVELOPMENT OF HIGH-ASSURANCE DISTRIBUTED SYSTEMS, 2nd international workshop on requirements engineering for high assurance systems. Phase 3 California, USA in conjunction with the 11th IEEE international requirements engineering conference.

[2] B. Mukherjee, L. T. Herbelein and K.N Levitt. Network Intrusion Detection. IEEE Network, vol 8, no. 3, pp-26-41, May/June 1994.

[3] B.L Theraja and A.K Theraja, A Textbook on Electrical Technology, 2003, 23rd Edition, PP 1887 – PP 1888.

[4] Jakob Nielsen's Alertbox. Usability 101: Introduction to us- ability, February 2013. http://nngroup.com/articles/usability-101- introduction-to-usability/.

[5] J. P. Anderson. Computer

[6] Giorgio Rizzoni, Principles of Electrical Engineering, 2003, 3rd Edition,

[7] Ronald .J Tocci, Digital Systems, Arentice – Hall. Inc. USA, 1988.

[8] Open Handset Alliance. Industry leaders announces open platform for mobile devices, November 2007. http://openhandsetalliance.com/press 110507.html.

[9] Mark Burgess, C programming tutorial, (K & R version 4).

[10] Samuel Jan and Diarah R (2014), Microcontroller based security system with intruder, *Volume 9, Issue 1 Ver. II (Jan. 2014), PP 01-08*

[11] Oshevire and Oladimeji 2012, Design and implementation of a Micro controller based burglar alarm displaying Available: http://scienceq.org/Journals/JAET.php

[12] Ezinemark, Home intruder System, Retrieved Oct 2014 From: **http://home.ezinemark.com/home-intruder-system-267c66fb2c.html**

[13] Motocycles,Intruder Motocycles article retrieved Oct 2014 From: **http://motocycles.com/pages//Intruder-Motocycles.html**

[14] Street Directory, Home intruder System video, Retrieved Oct 2014, From: **http://www.streetdirectory.com/etoday/video/wfleuc/home-intruder-system-video.html**

[15] IOSRJOURNAL, Intruder/invader system in environment, retrieved Oct 2014, From: http://www.iosrjournals.org/iosr-je

[16] 8051 Family, How to program in C language, Retrieve Oct 2014, From: http://what-when-how.com/8051-micro [7]

[17] WIKIPEDIA, How to interface Relay with microcontroller, Retrived Oct 2014, From: http://en.wikipedia.org/wiki/Relay#.

[18] CALYPTIX, Blog on Microcontrollers family, Retrieved Oct 2014, From: http://www.calyptix.com/malware/pos.