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Automatic Lighting System Using Multiple Robotic Lamps

K. Swarupa
M.Tech Student,
Department of ECE,
KITS for women's, Kodada, T.S, India.

Mr. M. Narasimha Rao
Associate Professor,
Department of ECE,
KITS for women's, Kodada, T.S, India.

ABSTRACT:

Intelligent lighting refers to stage lighting that has automated or mechanical abilities beyond those of traditional, stationary illumination. Although the most advanced intelligent lights can produce extraordinarily complex effects, the intelligence lies with the programmer of the show rather than the instruments or the lighting operator. For this reason, intelligent lighting is also known as automated lighting, moving lights or moving heads. This paper proposes Global System for Mobile Communications [GSM] based security system and automatic lighting system by using 3 degree of freedom [DOF] spherical type Robotic lamp. This integrated security system can provide motion in 3 directions for illuminating, tracking and capturing the movements of the human in confined area as well as to send an additional SMS alert to the concerned authority .The robotic lamp consists of three stepper motors for controlling the direction of orientation and also to control the intensity of light by zooming in and out. Also, it has infrared sensor to identify the location of person. The actuation of motor is done using microcontroller based system. When sensors of the security integrated system detect a person, signals are transmitted to the microcontroller to control the actuation of the motors, and sends SMS to the mobile number through the GSM. Lamp will illuminate, track and captures the movements of the human body. The two major functions of this integrated system are illuminating, tracking and recording the exact location of a person in the security enabled area and instantaneous sending of SMS alert to the concerned telephone number. , Keywords: 3 degree of freedom [DOF] spherical type Robotic lamp, Global System for Mobile Communications [GSM] based security system, additional SMS alert.

1. INTRODUCTION:

Security is primary concern to everyone. Security SMS alert system that can used to monitors in industries, banks, offices, government sectors with the help of Passive Infra Red [PIR] sensors. There are many types of sensors are available in the market, PIR sensor, Ultrasonic sensor, Laser scanner, position sensing device etc. which can detect the person. PIR sensor detect the human body by measuring the body temperature and identifies the obstacle and human body[1],[2], and PIR sensor is not suited for real time operation[3]. A laser scanner measure the distance between the sensor and objects [4],[5], and light is not affected to measure distance between sensor and object.[6], so it is help to detect the moving objects. In this project PIR sensor is used to detect the human body movement. The GSM based security system is developed to build a security system for a home/office/Industry to prevent the other persons to enter into the important room/chamber by sending SMS through GSM to alert the person. GSM, which stands for Global System for Mobile communications,

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reigns (important) as the world's most widely used cell phone technology. The importance of the robotic lamp is to illuminate the person. LED lamps are used because it requires less power and brighter than incandescent lamp. Breazeal and Hoffman [7] proposed a table-mounted robotic lamp, which has 5-degreeof-freedom (DOF) serial type of arm and lights a human face or tracks human gestures. It also has a movable aperture that can change the width of the light. However, because this robot tracks a person using a camera, there is a time delay due to image processing even with a fast processor(e.g., 2× Dual 2.66 Hz Intel processor).This type of serial robot is large and heavy and has a high inertia and deflection. Thus, it is difficult to install on a ceiling or wall. Lee et al. [8] proposed a 3- DOF robotic lamp. This robot tracks the position of one person inside a room with the aid of a PIR sensor. In this paper, we propose a ceiling-mounted 3-DOF robotic lamp to realize an automatic lighting system to track and illuminate the person with the help of PIR sensor and captures the activity of the person inside the room as well as it sendsSMS alert system which provides security system to the office, home, banks, any government sectors etc. It is designed using a light and compact spherical parallel mechanism. Because the robotic lamp is a hemispherical shape, it is suitable for installation on the ceiling. This paper is organized as follows: The robotic mechanism and its design are introduced in Section 2. Section 3 describes the architecture of the automatic lighting system. Section 4 describes the experimental work. Finally, we draw our conclusions in Section 5.

There are many patents dating back from 1906, with Edmund Sohlberg of Kansas City. The lantern used a carbon-arc bulb and was operated not by motors or any form of electronics, but by cords that were operated manually to control pan, tilt and zoom.

1925 saw the first use of electrical motors to move the fixture, and with it the beam position, by Herbet F. King (Patent number: 1,680,685). In 1936 patent number 2,054,224 was granted to a similar device, with which the pan and tilt were controlled by means of a joystick as opposed to switches. From this point on until 1969, various other inventors made similar lights and improved on the technology, but with no major breakthroughs. During this period, Century Lighting (now Strand) started retailing such units specially made to order, retrofitted onto any of their existing lanterns up to 750 watts to control pan and tilt.

George Izenour made the next breakthrough in 1969 with the first ever fixture to use a mirror on the end of an ellipsoidal to redirect the beam of light remotely. In 1969, Jules Fisher, from Casa Manana area theatre in Texas saw the invention and use of 12 PAR 64 lanterns with 120watt, 12volts lamps fitted, 360 degrees of pan and 270 degrees of tilt, a standard that lasted until the 1990s. This lamp was also known as the 'Mac-Spot' [1]

In Bristol in 1968, progress was also being made, mainly for use in live music. Peter Wynne Wilson refers to the use of 1 kW profiles, with slides onto which gobos were printed, inserted from a reel just like on a slide projector. The fixtures also had an iris, a multiple coloured gel wheel. These lights were also fitted with mirrors and made for an impressive light show for a Pink Floyd Gig in London. Another fixture known as the 'Cycklops' was also used for music in the USA, although it was limited in terms of capabilities. With only pan, tilt, and color functions, and at 1.2meters long and weighing in at 97 kg including the ballast, they were heavy and cumbersome. These units were designed more for replacing the ever unreliable local spotlight operators.

In 1978 a Dallas, Texas-based lighting and sound company called Showco began developing a lighting fixture that changed color by rotating dichroic filters. During its development, the designers decided to add motors to motorize pan and tilt. They demonstrated the fixture for the band Genesis in a barn in England in 1980. The band decided to financially back the project. Showco spun off their lighting project into a company called Vari-Lite, and the first fixture was also called the Vari-lite. It also used one of the first lighting desks

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with a digital core and this enabled lighting states to be programmed in.

Genesis was later to order 55 Vari-lites to use in their next chain of gigs across the UK. The lights were supplied with a Vari-Lite console which had 32 channels, five 1802 processors and a dramatic improvement of the first console which was very simple and had an external processing unit.
In 1986 Vari-Lite introduced a new series of lighting fixtures and control consoles. They referred to the new system as their Series 200, with the new lights designated "VL-2 Spot Luminaire", and "VL-3 Wash Luminaire". The Series 200 system was controlled by the Artisan console. Vari-Lite retroactively named the original system "series-100". The Original Vari-Lite console was retroactively named the "series 100 console" and the original Vari-Lite was retroactively named the "VL-1 Spot Luminaire". The prototype fixture shown to Genesis in 1980 was re-designated the "VL-zero" in the mid-1990s to keep the naming consistent.

In 1985, the first moving head to use the DMX protocol was produced by Summa Technologies. Up till that time, moving lights were using other communication protocols, such as DIN8, AMX, D54 and the proprietary protocols of other companies, such as VariLite, Tasco, High End and Coemar. The Summa HTI had a 250watt HTI bulb, 2 colour wheels, a Gobo wheel, a mechanical dimmer and zoom functions.

The first purchasable/mass-produced scanner was the Coemar Robot, first produced in 1986. Initially produced with either the GE MARC350 lamp, or the Philips SN250. Later versions were factory equipped with the Osram HTI400, a modification that High End Systems had been doing since 1987. The Robot used model aircraft servo motors to control Pan, Tilt, Color and Gobo, with the gobo wheel providing the shutter function as well. The Color wheel had 4 dichroic color filters (Red, Blue, yellow, and Green), and the gobo wheel contained 4 stamped patterns (non-replaceable). The Robot communicated with a proprietary 8bit protocol, yet had no microprocessors/pal's/pics/ram, O/S or other modern logic device.

In 1987, Clay Paky began producing their first scanners, the Golden Scan 1 & Crystal Scan. They utilized stepper motors instead of servos and used a HMI 575 lamp, bright and with a far more uniform beam brightness. This was followed by the Intellabeam in 1989, released by High End, who, at the time were the Distributors for Clay Paky.

In the 1990s, the future came closer with Martin, a Danish Company that produced Fog Machines. They began to manufacture a line of scanners known as Roboscans, with a variety of different specifications for different users. They were named for their wattages, with a range starting with 1004 and 1016. Later came the 804 and 805, designed for small venues. Other models were the 218, 518, 812, 918 and 1200Pro units. Martin also produced a whole new range of Moving Heads called the Martin Mac Series. This series is still extremely popular today, with new fixtures such as the Mac III and Mac Viper, which are among the highest quality moving lights.

The most recent development in intelligent lighting is digital lighting, with fixtures such as High End System's DL3. These fixtures consist of a bright LCD or DLP projector mounted on a moving yoke, much like that of an ordinary moving head. These fixtures also contain an integrated media server, which allows for millions of colour choices, endless libraries of gobo-like images, and projection of images and video.

2. METHODOLOGY:

The main objective of the proposed surgical anipulator is to implement the ability of orkspace conversion, in which the workspace for MIS can be converted to that for open surgery. Suturing is very complicated and important during surgery, so we assume that it is one of the most important tasks for the surgical manipulator to achieve in both MIS and open surgery with 6 DOF. If the surgical manipulator has a

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workspace like that of an articulated manipulator, it can attach and detach the surgical tool without human assistance using a tool loader. We used the open surgical suturing motion data obtained in Villanueva (2000) [9]. In that study, five experienced surgeons (four surgical fellows and one faculty from UCSF Department of Surgery) were asked to perform a simple knot tying task while the motions ofsurgical instruments were tracked by 6 DOF trackers. The task involved driving a curved needle into a foam rubber pad followed by tying several knots in an open surgical setting. The surgeon used a pair of needle drivers with their right hand and forceps with their left hand. The motions of the instruments were tracked by miniBIRD 6 DOF magnetic tracking devices (by Ascencion Technologies, Inc.) placed on the instruments. The miniBIRD was selected because the small size ofthe receiver (18 mm x 8.1 mm x 8.1 mm) allowed the surgeons to perform the task with minimal physical constraint. It has a resolution of0.5 mm in position and 0.1◦ in orientation. Data was recorded at 25 samples per second. Each surgeon repeated the task for 5 trials. *Concept Design of the Surgical Manipulator* To satisfy FR1 in Table I, the surgical manipulator has a kinematic structure with a RCM for MIS, and when the workspace of MIS is converted to that of open surgery, the kinematic structure of the surgical manipulator can be ransformed to create a larger workspace, like that of an articulated manipulator (e.g., PUMA 560 manipulator). To have a RCM for MIS, we can use the kinematic structures such as the double parallelogram, the single spherical linkage, and theC-arm. However, these structures have a mechanically fixed RCM, making it difficult to transform their workspace into that of the articulated manipulator with no RCM by simply adding revolute joints. We present a redundant kinematic structure with three revolute joints on a plane. This kinematic structure enables the manipulator to have an arbitrary and programmed RCM on a plane using software. This RCM can be called a "virtual remote center of motion (virtual The constructional details of robotic lamp are depicted in Figure 1. Two parallel guide linkages are used to provide tilting motions for the lamp to track a person. The two stepper motors are used to provide the tilting motion using these two guide ways and the zoom-in and zoom-out motions are created by a bevel gear set, along with screw transmission operated by the additional motor provided in the system. The Motor was chosen by considering the speed of a person in daily life which may be is less than 1 m/s. The maximum speed of the tilting motions is 1.3 rad/s. Therefore, if the robotic lamp is installed at a position higher than 1m, it does not have the speed problem. The maximum torque of motor was selected so that it is able to cope with an expected dynamic motion of the robotic lamp.Figure 1 also shows the side view of the robotic lamp and its sub- systems including a lamp module, parallel linkage, and a base frame with actuators

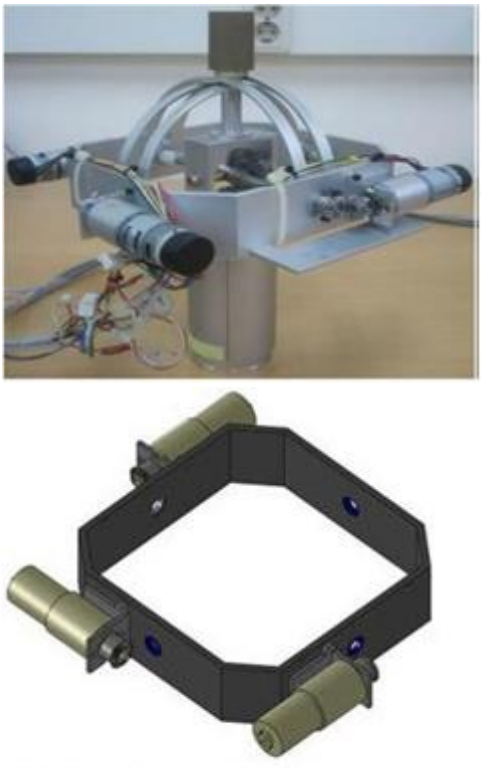

Figure:1 construction of 3DOF robotic lamp

There are several features in the robotic lamp. Using the spherical-type parallel mechanism, the two actuators are used to create the tilting motion and one motor is used for the zoom in and zoom out motions. The parallel linkage can operate the guide axis of the

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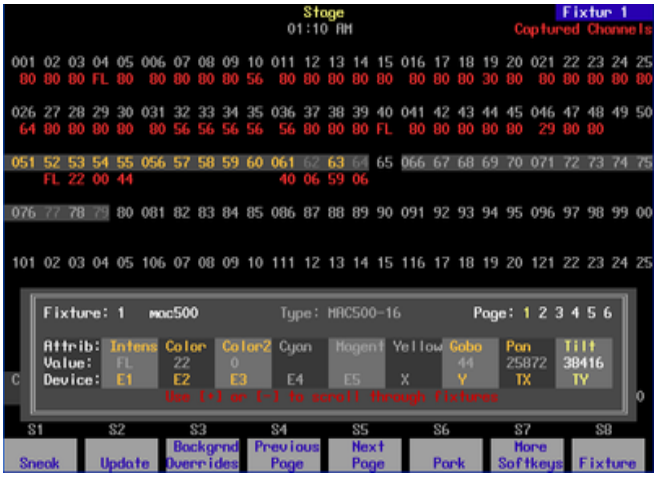
robotic lamp without applying any additional force to the guide linkage. Moving lights are controlled in many ways. Usually the fixtures are connected to a Lighting control console, which outputs a control signal. This control signal sends data to the fixture usually in one of three ways: Analogue (which has largely been phased out), DMX (which stands for "Digital Multiplex", also the industry standard control protocol), orEthernet Control (such as ArtNet or sACN). The fixture then takes this signal and translates it into internal signals which are sent to the many stepper motors located inside.

DMX connectors, the most common method of controlling moving heads. Note that these are 3-pin DMX connectors, which are used by some manufacturers, rather than the 5-pin, which specified by the USITT DMX-512 Standard.

The vast majority of moving heads are controlled using the DMX protocol, usually using dedicated twisted pair, shielded cable [1] with 5-pin XLR connectors at the ends.[2] Each fixture is assigned a block of DMX *channels* in one of the venue's DMX *universes* (a self-contained set of cables and fixtures which can operate a maximum of 512 individual channels). The central lighting desk transmits data on these channels which the intelligent fixture interprets as value settings for each of its many variables, including color, pattern, focus, prism,pan (horizontal swing), tilt (vertical swing), rotation speed, and animation.

Since moving heads did not attain prominence until DMX's predecessor, AMX, or Analog Multiplex had passed the zenith of its popularity. Very few moving heads use analogue control, due to crippling restrictions on bandwidth, data transfer speeds and potential inaccuracy. Some of the most modern intelligent fixtures use RJ-45 or Ethernet cabling for data transfer, due to the increased bandwidth available to control increasingly complicated effects. Using the new Ethernet technology, control surfaces are now able to control a much larger array of automated fixtures.

The most recent development in lighting control is RDM (lighting), or Remote Device Management. This protocol allows for communication between the lighting controller and fixtures. With RDM, users can troubleshoot, address, configure, and identify fixtures from the RDM enabled lighting desk.



Moving lights are programmed using a fixture box in ETC light boards

Moving lights are much more difficult to program than their conventional cousins because they have more attributes per fixture that must be controlled. A simple conventional lighting fixture uses only one channel of control per unit: intensity. Everything else that the light must do is pre-set by human hands (colour, position, focus, etc.) An automated lighting fixture can have as many as 30 of these control channels. A slew of products are available on the market to allow operators and programmers to easily control all of these channels on multiple fixtures. Lighting boards are still the most common control mechanism, but many programmers use computer software to do the job. Software is now available that provides a rendered preview of the output produced by the rig once fixtures are connected to the program or

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console. This allows programmers to work on their show before ever entering the theater and know what to expect when the lights are connected to their controller. These products usually feature some method of converting a computer'sUSB output to a DMX output.

While it is true that moving lights have in a sense "revolutionized" the world of concert and other event lighting, to call these fixtures "intelligent" can be offensive to some people. In fact, not every person involved in the music production business feels that moving lights are intelligent, necessary, or even desirable at all. While this type of technology can be used very effectively, there are many instances in which it simply distracts an audience from the musical content on stage. In this case, to call this lighting "intelligent" can be the source of much confusion.

3. IMPLEMENTATION

Lighting system:

The automatic lighting system is consists of one robotic lamp, PIR sensors, motion control board, and microcontroller to manage the whole system. Robotic lamp tracks and lightens each person. Microcontroller, sensor and motion control board communicate each other through the RS-232. PIR sensor is detects the position of people. Data on people positions are gathered and transferred to the microcontroller. The microcontroller then transferred 8 bit digital signals to the diver, which is designed to control at most two motors simultaneously. Therefore, the three desired direction of one robotic lamp is controlled by two drivers. Figure-2 shows the block diagram of the robotic lamp.

PIR sensor:

PIR sensors allows to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in home businesses.

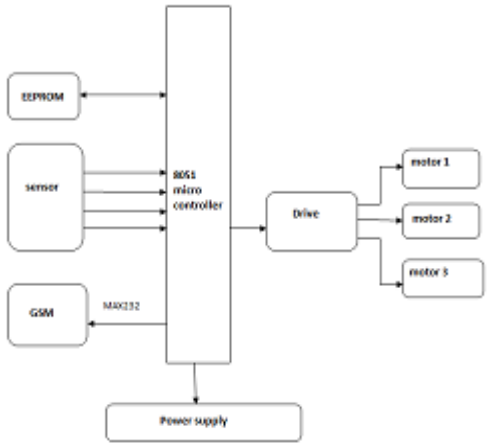

Figure:2 Block diagram of integrated security system

Microcontroller 8051:

8051 Microcontroller is a 40 PIN Integrated Circuit and is popular 8 bit microcontrollers and has an instruction set that enable coding of tiny, I/O intensive, application with large Program Memory that it is possibly to be used with C. Greatly used in embedded systems. The designation for this family is MCS51.The microcontroller was build using NMOS. However the version recognized by a C (80C51) use CMOS. It has an instruction time of 1µs (at 12 MHz) newer one may perform 40 instructions per 1µs at 40 MHz.

GSM (Global System for Mobile communication):

GSM, which stands for Global System for Mobile communications, reigns (important) as the world's most widely used cell phone technology. Cell phones use a cell phone service carrier's GSM network by searching for cell phone towers in the nearby area. Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication.GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band.

This security system is developed with aims to improve security systems available in current market. This project claims to produce a prototype 3-DOF robotic lamp with camera and global system for mobile communication (GSM) interfacing system for office,

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banks, home, industry and any government sector security.

This system uses PIR (passive infrared receiver).The PIR function is to detect changes in temperature of human in infrared radiation. The microcontroller 8051 is used, where it sends signal to motion control board to activate the 3-DOF robotic lamp and camera when the microcontroller receives signals from PIR sensor. To develop software for 3-DOF robotic lamp to the control motion of the actuators embedded c coding is used. Once the 3-DOF robotic lamp is activated it will start to illuminating and tracking the person and camera will start recording movement of the person. At the same time microcontroller send signals to the GSM and sends SMS to the mobile phone, sending process will automatically operate.

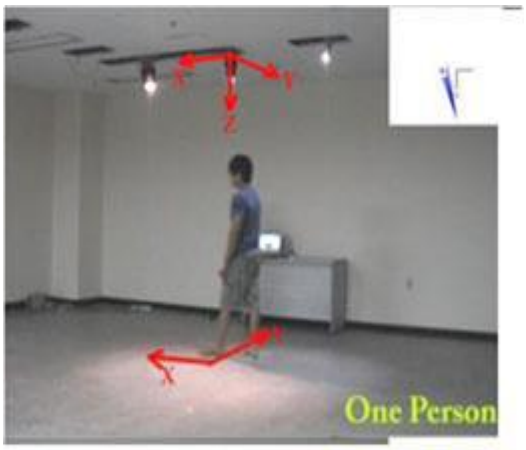
4. DISCUSSION

Tracking and illuminating by robotic lamp:

3-DOF robotic lamp was installed on the ceiling. When sensor detects the person LED lamp was activated and starts tracking and illuminating the person. Three motors are used in the system, in which two are used to control the actions of the lamp and helps to track the person and one more motor is used for to control the zoom in and zoom out motion. And camera is installed in between the LED lamp to capture the image and activities of the person. When person is entered into the room sensors are detected person at the same time microcontroller collects the data and send signal to the drive to start the motor and robotic lamp get activated as well as microcontroller send signal to the GSM for to Send SMS to the mobile number which are stored in the EEPROM. Figure 3 shows ceiling mounted robotic lamp.

4.2.Zoom-In and Zoom-Out Motion:

The zoom motion is changed continuously according to the distance between the robotic lamp and a person. For example, when the person is far from the robotic lamp, the zoom-out motion is used to focus the light on the person. The intensity of the light gets stronger to light the person at a greater distance. Figure- 4 shows the zoom-in and zoom-out motions of the robotic lamp.



Intelligent lights (now commonly referred to as automated or moving heads), can be used wherever there is a need for powerful lighting which must be capable of rapid and extreme changes of mood and effects. Moving heads would, therefore, be inappropriate in a setting which does not require strong lighting (such as a home) or where the “quality” of the light required does not vary excessively (although it may need to be very strong for a venue like a stadium). Naturally, there are exceptions to this rule, most notably the use of large numbers of moving heads for international sporting events, such as the Commonwealth Games[5] or Olympic Games,[6] where many thousands of separate automated fixtures are often used to light the opening and closing ceremonies. The 2008 Summer Olympics, in Beijing, had a rig of around 2,300 intelligent fixtures which is "the largest single automated lighting system ever assembled for a single event"[7]

Usually, however, the use of intelligent lights is confined to theatre, concerts and nightclubs, where the versatility of these fixtures can be utilised to its best extent. In these applications, the uses of fixtures can be informally grouped into two categories: active and passive(although these are not standardised terms).

Passive use of automated lighting involves utilizing their versatility to perform tasks which would

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otherwise require many conventional lights to accomplish. For example, six to eight moving heads can create a textured blue "night" effect on the stage floor while applying amber light to the actors during one scene - this can create a sensation of dusk or night. At the flick of a switch, the fixture can change to an animated red "fire" effect for the next scene. Attempting this transition with traditional lighting fixtures could require as many as thirty instruments. In this circumstance, the automated fixtures are not doing anything that could not be achieved using conventional fixtures, but they dramatically reduce the number of lights needed in a rig. Other features of automated fixtures, such as rotating gobos, are also possible with conventional fixtures, but are much easier to produce with intelligent fixtures.

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6. CONCLUTION

The security integrated system using 3-DOF robotic lamp for security application with SMS alert system was designed to provide high security to the industries, banks, office and any government sectors. A robotic lamp with three DOFs creates the tilting motion for tracking, lighting and capturing the activities of the people and the zoom-in and zoom-out motions to control the intensity of the light. It sends SMS to the cell phone to alert.

This research work was studied and implemented as a complete working model using microcontroller. The programming and interfacing of microcontroller was implemented for the successful operation of the security system. Also, this research includes the study of GSM modem by using sensor. This research involves the application of using PIR sensor for getting the acknowledgment from GSM modem to our mobile numbers which are stored in EEPROM and GSM network operators have roaming facilities. User can also get SMS alert to their mobile phones, when they travel overseas

Fig. 6. (a) Measurement of the actual angle of the pitching joint. Measurement of the actual angle of the distal rolling joint. Measurement of the gripper force. Measurement of the lifting force

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Author Details

Miss. **K.Swarupa**.
M.Tech Student, Department of ECE in **KITS for women's**, Kodada, T.S, India.

Mr**. M. Narasimha Rao**
Working as a Assistant Professor at ECE in **KITS for women's**, Kodada, T.S, India JNTUH Hyderabad. He has 4 years of UG/PG Teaching Experience.