ISSN Print : 2320-2084, Online : 2321-2950

International Journal of Electrical, Electronics and Data Communication (IJEEDC)

Volume No. 12
Issue No. 2
May - August 2024

ENRICHED PUBLICATIONS PVT. LTD
JE-18, Gupta Colony, Khirki, Extn, Malviya Nagar, New Delhi-110017
PHONE : - + 91-8877340707
E-Mail : info@enrichedpublications.com

ISSN Print : 2320-2084, Online : 2321-2950

International Journal of Electrical, Electronics and Data Communication (IJEEDC)

Aim & Scope

International Journal of Electrical, Electronics and Data Communication (IJEEDC) is having eISSN: 2320-2084 , pISSN:2321-2950, Peer reviewed, Open Access, Indexed and monthly International Journal, being published since year 2013.

IJEEDC is an academic highly reputed, online, open access, peer reviewed international journal. It aims to publish original, theoretical and practical advances in Computer Electrical, Electronics and Communication Engineering and all interdisciplinary streams of Engineering Sciences. All submitted papers will be reviewed by the board of committee of IJEEDC.

Goals Our goals are to promote the co-operation between the professionals in various fields of the Engineering and management to cultivate an environment for the advance and development of the technology. Our objective includes

- Promoting the interactions between the Electrical, Electronics and Communication Engineering
- Advancing the application of engineering techniques from the academics to the industry.
- Facilitating the exchange of information and ideas among the engineers, Scientists, Researchers and academicians easily.

Original ideas may be discussed in advance with the Editor (mail: info.ijeedc@gmail.com), to clear the ground for a draft submission. All papers are then peer-reviewed by relevant experts and feedback is given whether or not a paper is accepted or returned for further work. The Editor's policy is to try and accommodate contributions of all sizes above the minimum threshold where length is dictated by the needs of the subject matter.

IJEEDC publishes both theoretical and experimental high-quality papers of permanent interest, In addition to peer-reviewed original research papers, the Editorial Board welcomes original research reports, state-of-the-art reviews and communications in the broadly defined field of Electronics, Electrical Engineering and Data Communication.

The Journal can be found from the official URL www.ijeedc.iraj.in

ISSN Print : 2320-2084, Online : 2321-2950

Editor-in-Chief

Publication and Distribution Head

International Reviewers Board

ISSN Print : 2320-2084, Online : 2321-2950

ISSN Print : 2320-2084, Online : 2321-2950

International Journal of Electrical, Electronics and Data Communication (IJEEDC)

(Volume No. 12, Issue No. 2, May - August 2024)

Contents

ISSN : 2320-2084

FIELDS CONCEPTUAL CHANGE INVENTORY: A DIAGNOSTIC TEST INSTRUMENT ON THE ELECTRIC FIELD AND MAGNETIC FIELD TO DIAGNOSE STUDENT'S ONCEPTIONS

NAGANATHAN MATHUR MALAICHAMY, RAGURAJ SEKAR
1,2 SRM University, Chennai.

ABSTRACT

- Fields Conceptual Change Inventory (FCCI) is a diagnostic test instrument to diagnose student's conception on the electric and magnetic field. FCCI has been developed since 2012 for surveying conceptions of students who learn Basic Physics II in Indonesia University of Education (UPI). FCCI design was based on highly desire of researchers to identify every concept on electric and magnetic field. Developing these instruments has been producing some analysis in electricity and magnetism concepts. Nowadays conceptual change is one of main issues to do research in science education especially physics education. As a consequence researchers want to diagnose conceptions of pre-service teachers on the electric and magnetic field. FCCI has been developed into two parts, the first is FCCI for diagnosing electric field and the second part is FCCI for diagnosing magnetic field. In this work authors focus on describing FCCI to diagnose conceptions of students on electric and magnetic field. As many as thirty three students have been surveyed by testing FCCI instrument in Odd Semester 2014/2015 and data was processed to analyze conceptions in some categories, those are: understanding of concept, parallel (partially) conceptions, misconceptions and do not understand of concept. Data were analyzed by using percentage and described both quantitatively and qualitatively. To sum up pre-service teachers have variety conceptions on electric and magnetic field which is very useful to be a baseline for next research.

I. INTRODUCTION

Nowadays misconceptions have been one of significant domain research in science education, more specific at physics education. Misconceptions among students on complex and abstract physics concept can be met worldwide. Students which experience misconception difficult to change from wrong to correct knowledge. Students' misconception can only be converted into the correct concept next to scientific conception. If students have internal motivation to change which is known as conceptual change. As of misconceptions, conceptual change has also become one of the most crucial research domains in the study of Science Education, especially Physics Education. The first conceptual change models, developed by Posner, et al. [1] has become the most influential theory since the beginning up to now. This conceptual model has been developed to describe the change of learning as the relationship between existing knowledge with new knowledge that leads to the four conditions, namely: issatisfaction, clarity (intelligibility), the sensible thing (plausibility) and success (fruitfulness). Various studies as a base model on conceptual change approach involving cognitive conflict in it can be found in Ref. [2]; Ref. [3]; and Ref. [4]. Cognitive conflict strategy is more emphasis on students' self-esteem instability(destabilizing the student's confidence) on specific concepts through experience opposites as discrepantevent. All models of conceptual change approach had been proven working effectively and optimally when researchers conducted a diagnosis prior to the respondent that would be the subject of subsequentresearch. To solve this issue, researchers have developed an FCCI (Fields Conceptual Change Inventory) instrument in the form of three-tier test (T three). FCCI instrument consists of two

concepts, namely the electric field and magnetic field. In this article, the researchers focus on FCCI instrument to diagnose conception of pre-service physics teachers to the concept of electric and magnetic field learned in Basic Physics II. FCCI instrument development is modified from the structure of instrument developed by Vatansever [5] that made up the instrument in format of the three-tier test semi open-ended type, whereas the development of each tier (level) has been developed and compiled in first tier of several standard tests as in [5]; [6]; [7]; and [8]. Three Tier Test organized into three levels (tiers), namely: the first tier to the standard question in the form of multiple choice with five choices, the second tier is given a blank for an explanation of the chosen answer and third tier contains level of confidence (confidence rating) of the answers, namely: very confident, not confident and do not know.

II. THEORETICAL FRAMEWORK

FCCI instrument has been developed by employing 4D model, namely: 1) Defining, 2) Planning, 3)Developing and 4) Disseminating. In defining phase, researchers investigated the concept that would be put into the instrument through a case study about the spread some standard questions Ref. [5] and the resulting development of the concept of the FCCI instrument is focused on the concept of vector fields (electric and magnetic fields).

In the second phase (planning), team of researchers conducted preparation and planning in determining the research subjects and course studied. Determination of physics course as the research subject by doing the analysis of the initial study (case study) result which states that the Basic Physics II is a subject which was very influential in mastering the concept of Physics for pre-service teachers. This course is conducted in the third period (3rd semester). Development phase is the core of FCCI development, that could help researchers to diagnose student conceptions related to the concept of the electric field so that the research could proceed smoothly and obtained quantitative and qualitative analysis to support the subsequent data analysis. The last phase (disseminating) performed and given to students who are enrolled in Basic Physics II course at class B on the Department of Physics Education in academic year 2014/2015. FCCI instrument on the concept of the electric fieldconsists of 13 questions in the form of a three-tier test, all of which refer to electric field fundamental concept and another related concept within the same topic. Another FCCI instrument test has 14 problems set on magnetic field shown below is a problem of FCCI instrument on electric field (no.5):

(5). A positive charge can be put at one point in two different positions in a region with a uniform electric field, as shown below. How is the comparison of electric force on the charge for position 1 and 2?
a. Electric force is greater at position 1.
b. Electric force is greater at position 2.
c. Electric force at position 2 is zero.
d. Electric force at both position is the same, but not zero.
magnitude but opposite direction.

Explanation:

The level of confidence for the chosen answer:
a) Very confident b) Not sure c) Do not know Whereas one of a problem of FCCI instrument on magnetic field (no.3) as an example is: (3). An electron with initial velocity $\vec{v}$ enters the uniform magnetic field $\vec{B}$ region, with direction toward the paper. The electron velocity is perpendicular to the magnetic field direction as shown below. Ignoring the earth's gravity.

How many forces do act on the electron when it pass?
a.One, it is the force acts on the moving electron outside the uniform magnetic field.
b. One, it is the magnetic force.
c.Two, they are the forces act on the moving electron inside the uniform magnetic field and
d. the magnetic force.
e. Two, they are the electric force outside the uniform magnetic field and magnetic force.
f. There is no force acting on the electron.

Explanation:

The level of confidence for the chosen answer:
a) Very confident b) Not sure c) Do not know Criteria for diagnosis of students' conceptions o

Misconception (M): Tier I and Tier II are wrong and confidence rating is "very confident"
Understanding the Concept (UC): Tier I and Tier II are correct and confidence rating is "very confident"
Parallel Conceptions (PC): Tier I and Tier II are correct and the confidence rating is "not sure" or "do not know"
Do not Understand the Concept (NUC): Tier I and Tier II are wrong and the confidence rating is b) "not sure" and "do not know".

III. RESEARCH METHOD

A survey method was conducted to obtain the profiles of 33 pre-service physics teachers The subject research was tested by using FCCI instrument the form of open-ended three-tier test within 50 minutes duration of lecturing. The survey was conducted prior the students learned about electric and magnetic field concept on the course of Basic Physics II.

IV. RESULT AND DISCUSSION

Conducted survey research data was the diagnostic result of a profile of student's conceptions that contracting Basic Physics II course in the academic year 2014/2015. Quantitative data were expressed in percentages while qualitative data was obtained relevant data about the reasons for the answers on the first level. Here was a profile data of Physics student's conception to the concept of an electric field and magnetic field that were diagnosed using the 25% relative to 15%. This data become strong "alert" in order to push change previously lecturing in Basic Physics II course to scientific conception as already described in Sekercioglu & Kocakula [9]. All experts Physics and Physics Education have agreed, when studying the concept of electricity both static and dynamic requires the concept of electric field as the embodiment of the concept of electricity itself. It will be a difficult task to understand electricity concept comprehensively, if the student does not understand the concept of electric field well. According to Serway & Jewett [10] the field concept is needed in while explaining the abstract concept of electricity and magnetism and can serve as a bridge for the concept of electricity and magnetism become more compact to be understood. Besides concept of the electric and magnetic field need special chapter for more emphasis in the study of the concept. Quantitative data in Table 1 are supported by qualitative data come from students' response (that is their explanation/reason) related to tier I. As an example, below is response transcription from most students associated with the no. 5 previously shown.

1. Magnitude of the electric force is influenced by both of the charges and distance between. So there is no influence of the magnetic field as long as the particles in rest. 2. Because the (-) sign means the opposite direction to that the (+) sign. 3. Because at position 1 there is electric force influence (particle will be pushed). Based on 33 students' transcription of tier II for every question will obtain wide variety of reasons. Starting from wide variety of students' reasons, researchers summarize and selected the topfour alternative answers for each question. Then the reasons from those students are arranged in a semienclosed choice for the next development of FCCI instrument. Current structure and format of FCCI is in the form of threetier (3-level). Next the authors will change the level II .of open essays into four choices of reasons that have been prepared based on current study with additional one reason in essay format as an open alternative in case students do not choose the four options provided.

CONCLUSION

Our statistical diagnosis of students' conceptions who learned electric and magnetic field using FCCI test instrument in the form of open-ended three tier test is: understanding the concept about 15%, experience is conceptions about 25%, not understand about 41% and stay in parallel conception about 19 %.

REFERENCES

[1] G.J. Posner, K.A. Strike, P.W. Hewson, and W. A. Gertzog, "Accommodation of a scientific conception: toward a theory of conceptual change", Science Education, 66, 221–227 (1982)

[2] M.S. Kocakulah and M. Kural, "Investigation of conceptual change about double-slit interference in secondary school physics", International Journal of Environmental & Science Education 4 (4), 435-460 (2010) [3]

[3] H.C. She and Y.W. Liao, "Bridging scientific reasoning and copceptual change through adaptive web-based learning", Journal of Research in Science Teaching 47 (1), 91-119 (2010)

[4] H. Kucukozer and S. Kocakulah, "Effect of simple electric circuits teaching on conceptual change in grade 9 physics course", Journal of Turkhis Science Education, 5 (1), (2008)

[5] O. Vatansever, "Effectiveness of conceptual change instruction on overcome students' misconceptions of electric field, electric potential and electric Potential Energy at tenth grade level", Thesis Magister, The Graduate School of Natural and Applied Sciences of Middle East Technical University, Turkey, 1999, p. 107

[6] D.P. Maloney, T.L. O'Kuma, C.J. Hieggelke, A.V. Heuvelen, "Surveying students' conceptual knowledge of electricity and magnetism", Phys. Educ. Res., Am. J. Phys. Suppl., 69 (7), s13-s23 (2001)

[7] Bekele Gashe Dega, "Conceptual change through cognitive perturbation using simulations in electricity and magnetism: a case study in Ambo University, Ethiopia", Dissertation, University of South Africa, South Africa, 2012, p. 1-221

[8] Rhett Allain, "Investigating the relationship between student difficulties with the concept of electric potential and the concept of rate of change", Dissertation, The Graduate Faculty of North Carolina State University, Raleigh, Nort Carolina USA, 2001, p. 1-152

[9] A. G. Sekercioglu, & M. S. Kocakula, "Grade 10 students' misconception about impulse and momentum", Journal of Turkish Science Education, 5 (2), 47-59 (2008)

[10] Serway Jewett, "Physics fos scientists and engineers",.

ISSN : 2320-2084

1×8 EM COUPLED DUAL BAND LINEAR ARRAY ANTENNA WITH POINT TO MULTIPOINT COMMUNICATION FOR MILLIMETER WAVE APPLICATION

1DINESH CHAVAN, 2GEETAPATIL
1Student,2Professor, Poojyadoodapaappa College of Engineering, Kalaburgi, Karnataka

ABSTRACT

Communication system has changed very much in the past few years and would require a device with low cost, lower weight and a low profile that could operate at wide range of frequencies with high performance. The electromagnetically (EM) coupled array antenna is one of the possible solutions which is substitute for wide/multiband antenna. In EM coupled antenna patch and feed are separated by a substrate and transmission happens through coupling. The substrate used is RT/rogers-5880 with a dielectric constant of 2.2, tangent loss of 0.0009mm and height of 0.0635mm.The antenna is simulated using commercial tool Ansys HFSS. Parameters such as return loss, VSWR, gain, and radiation pattern are taken into account to design and simulate this array. The simulated antenna shows the return loss of -27.33dB for 55.6GHz and -37.02dB for 60.6GHz.

Index terms- EM Coupled, Microstrip Patch Antenna, 5G, Dual Band, Linear Array, and Point To Multipoint.

I. INTRODUCTION

In this modern era, as the technology is developing, devices used for transmission and reception are decreasing in size and increasing the complexity. The Microstrip Patch Antennas (MSPA) are the most efficient antennas as they have a low profile, lesser weight, and assume to have high gain. Different aspects of design of MSPA and variations with respect to its characteristics are discussed [1].As the frequency spectrum is congested it will be better to design an antenna which would operate at multiple frequencies. Electromagnetically [EM] coupled patch antenna could provide a better option.The MSPA designed for 60 GHz [2] are most suitable for the 5G applications. For various other applications the gain of the MSPA can be increased with help of antenna array structure. Since the lower band frequencies are congested, antennas at 60 region) are in demand. Such antennas also support gigabits/s data rates [3]. Another interesting fact [4] about millimeter wave range is its proximity to oxygen absorption peak, which contributes to attenuation of 15dB/km. Another fact is that a 15cm thick concrete wall can induce 36 dB of attenuation. This characteristic provides an isolation from nearby transmitter which could be used for frequency reuse and makes this spectrum very good in short range broadband communication. EM coupled antennas are multilayer antennas [5]. Simple EM coupled patch antenna would be consisting of 2 layers, substrate1, and substrate 2. These type of antenna are suitable for wideband/multiband operation. It is true that with the of help array model one can enhance the gain and directivity of any antenna [6]. Multiband and wide band can be achieved by array of EM coupled patch antenna. The fan beam pattern is used in point to multipoint cellular communication system. The wireless point to multipoint communication system fan beam antennas are used for sectorial coverage from central station [7-8]. The MSPA model has been designed and optimized using HFSS tool. Simulations are done and results are provided.

II. MICROSTRIP PATCH ANTENNA DESIGN

The approach here is to start with single EM coupled patch antenna. The patch thickness is smaller than the λ0.Substrate used here is RT/duroid-5880 (εr= 2.2 and tanδ=0.0009) with substrate thickness of 0.003λ0≤ h≤ 0.05λ0. The performance of microstrip antenna depends on its dimensions, operating frequency, radiation efficiency, return loss, VSWR. For efficient radiation, width of patch W is:

$$W=\frac{c}{(2fo\sqrt{(\epsilon_r+1)\frac{1}{2}})}. \quad (1)$$

The length of patch becomes

$$L_{eff}=L-2\times \Delta L \quad (2)$$

Where

$$L=\frac{Vo}{2f_r\sqrt{\epsilon_{reff}}}. \quad (3)$$

and

$$\frac{\Delta L}{h}=0.412\frac{(\epsilon_{reff}+0.3)\left(\frac{W}{h}+0.264\right)}{(\epsilon_{reff}-0.258)\left(\frac{W}{h}+0.8\right)} \quad (4)$$

and

$$\epsilon_{eff}=\frac{\epsilon_r+1}{2}+\frac{\epsilon_r-1}{2}*\left[\frac{1}{\sqrt{1+12*h/w}}\right] \quad (5)$$

Impedance for $\frac{w}{h}<1$

$$Zo=\frac{60}{\sqrt{\epsilon_{eff}}}\ln\left(\frac{8h}{w}+\frac{w}{4h}\right) \ ohms \quad (6)$$

for $\frac{w}{h}\geq 1$, the impedance is given by

$$Zo=\frac{120\pi}{\sqrt{\epsilon_{eff}}\left(\frac{w}{h}+1.393+\frac{2}{3}\ln\left(\frac{w}{h}+1.444\right)\right)} \quad (7)$$

III. MICROSTRIP PATCH ANTENNA ARRAY

After the construction of single patch antenna, using the same dimensions and spacing the construction of array is considered for further development, starting with 1×2 and ending at 1×8. The feeding network used is corporate feed network (power divider). The gap provided between patches would be 0.5*λ-0.75*λ depending upon the operating frequency used. Figure.1. shows a single EM coupled patch antenna, as we can see a separation between patch and feed line.

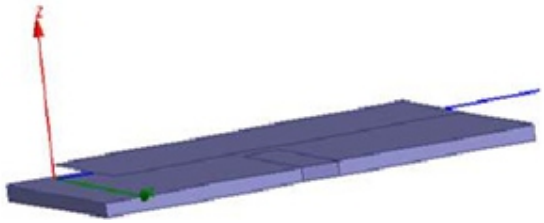

Figure 1: single EM coupled patch antenna

Figure.2shows 1x8 EM coupled linear array, in this transmission line forms a corporate feed network, patches are separated substrate.

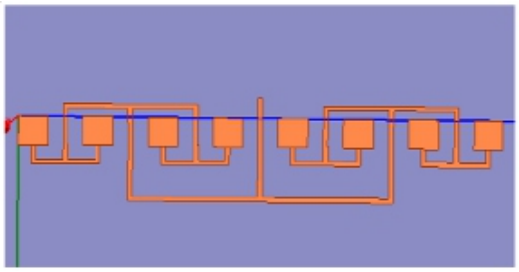

Figure 2: 1x8 with ground plane and lower layer substrate

The overview of 1x8 array antenna is shown in Figure.3, from the top view only patches are visible whereastransmission lines is separated substra

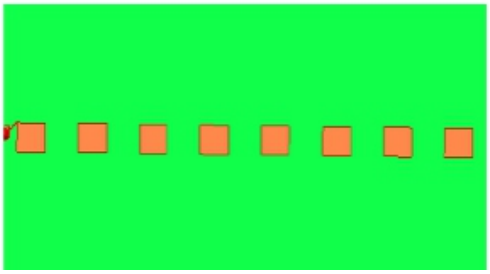

Figure 3: 1x8 complete antenna (overview).

The transmission lines are drawn below the substrate 1 and each time length and angle is considered along with impedance matching. The two substrates are of same size 0.0635mm each, and thickness of the patch will be 0.0035mm, and 50ohm feed line is matched to the array connecting patch with the help of quarter wave. The feed point is given exactly center of the array.

IV. SIMULATION RESULTS

After simulation and optimization of array the result found were satisfactory. Designed array provides dual band operation with minimum return loss and increased gain. The simulations are taken out for two operating frequencies and both were in the good understanding with the return loss and gain. Figure.4 shows graphical representation of return loss.

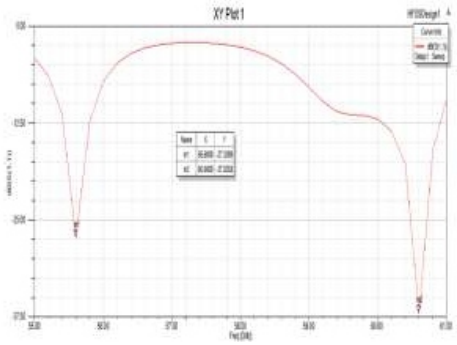

Figure 4: Return loss S11 at two frequencies

The results for shows return loss that the antenna array designed could work on two frequencies 55.6 and 60.6 GHz with return loss -27 and -37 dB Figure.5 and 6 shows gain obtained for MSPA. The designed MSPA is in good agreement with two frequencies. The MSPA designed is in good agreement with two frequencies 55.6 and 60.6 GHz. The MSPA designed is simulated two times with the above mentioned f

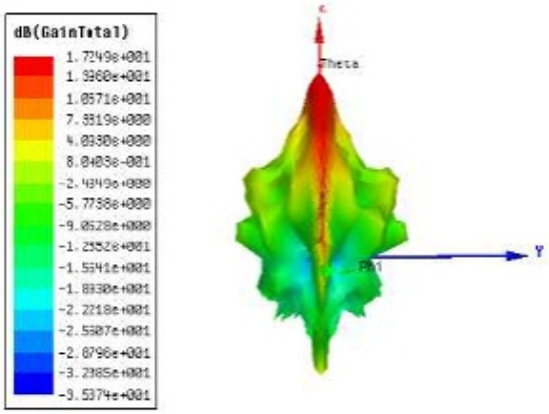

Figure 5: Gain for 55.6 GHz.

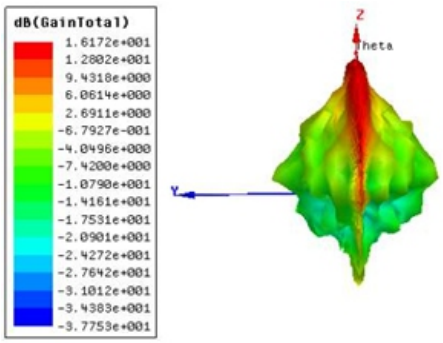

Figure 6: Gain for 60.6 GHz.

The gain obtained at 55.6 GHz is 17.24dB and 60.6 GHz is 16.17dB.Figure.7 shows the graphical presentation of VSWR, operating frequency indicates that the obtained VSWR for 55.6 GHz is 1.089 and 60.6 GHz is 1.028. As we know, VSWR less than 2 is a practically acceptable. The gain obtained at 55.6 GHz is 17.24dB and 60.6 GHz is 16.17dB.Figure.7 shows the graphical presentation of VSWR, operating frequency indicates that the obtained VSWR for 55.6 GHz is 1.089 and 60.6 GHz is 1.028. As we know, VSWR less than 2 is a practically acceptable.

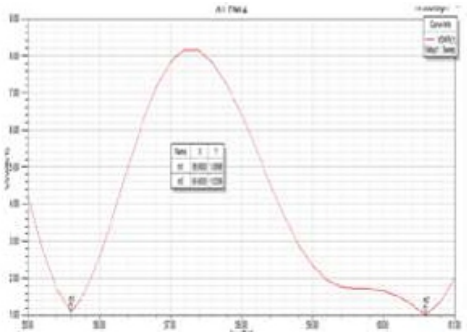

Figure 7: VSWR graph.

Radiation pattern important in determiningbeamwidth, beam shape, directivity of antenna. Figure.8 shows the 3D radiation pattern and Figure.9 shows polar plot.

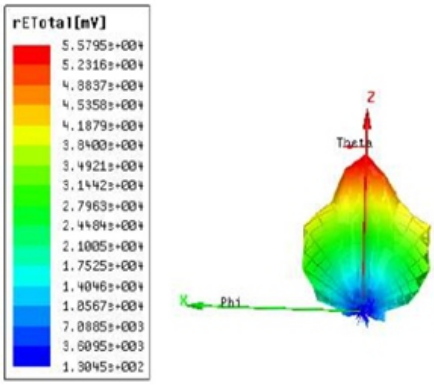

Figure 8: 3D radiation pattern

The beam width of the array is 80 deg. And directivity is 17.24dB.

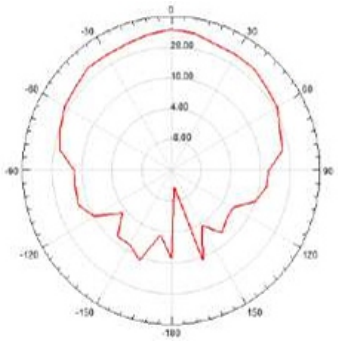

Figure 9: Radiation polar plot

CONCLUSION

The antenna designed here is 1x8 linear EM coupled antenna array. It is designed and simulated using HFSS which resonates at two different frequencies 55.6 and 60.6GHz. The return loss for 55.6 and 60.6GHz are -27dB and -37dB respectively. The gain of antenna at two frequencies 55.6 GHz is 17.24dB and 60.6GHz is 16.17dB. The VSWR measured are 1.08 and 1.02 for 55.6GHz and 60.6 GHz respectively. The unique characteristic of this antenna is simplicity to get higher performance. Its main application is in broadband 5G communication. The pattern produced is fan beam and it is suitable for point to multipoint communication. The mutual coupling has been reduced to accomplish ideal pick up.

REFERENCES

[1] R. B. Waterhouse "Microstrip Patch Antennas: A Designer's Guide" Springer Science Business Media, LLC.

[2] JyotiSaini,S.K. Agarwal "Design a Single Band Microstrip Patch Antenna at60 GHz Millimeter Wave for 5G Application"978-1-5090-4708-6/17/$31.00 ©2017 IEEE.

[3] Duixian Liu, Johannes Akkermans and Brian Floyd "A Superstrate Patch Antenna for 60-GHz Applications"T. J. Watson Research Center, IBM, Yorktown Heights, NY 10598, USA.*

[4] Bruce Bosco, Rudy Emrick, Steve Franson,John Holmes, Steve Rockwell "Emerging ommercial Applications Using the 60 GHzUnlicensed Band Opportunities and Challenges"1-4244-0849 0/06/$20.00 C 2006 IEEE.

[5] Rajesh Kumar Vishwakarma1 and K.K Verma2 "Electromagnetically coupled square microstrip antenna for dual-band operation"978-0-7695-4958-3/13 $26.00 © 2013 IEEE DOI 10.1109/CSNT.2013.18.

[6] Bilge Belentepe "Modeling and Design of Electromagnetically Coupled Microstrip-Patch Antennas and Antenna Arrays"IEEE Antennas and Propagation Magazine, Vol. 37, No. 1, February 1995

[7] Donald L. Runyon "Optimum Directivity Coverage of Fan-Beam Antennas" IEEE Antenna's and Propagation Magazine, Vol. 44, No. 2, April 2002.

[8] Kwon Kim, Stephane Pinel, Joy Laskar, and Jong GwanYook, "circularly and linearly polarized fan Beam patch antenna arrays on liquid crystal polymer substrate for V-band applications 2005 IEEE.

ISSN :2320-2084

DESIGN & APPLICATION OF VISIBLE LIGHT COMMUNICATION, VIDEO TRANSMISSION; CODING AND DECODING, THE COMMUNICATION PROTOCOL BASED ON LIGHTING EMITTING DIODE

MORTADA MOHAMMED ELDRDIRI AHMED
Electrical and Electronics Engineering Department, University of Science & Technology, Ammar Mohammed AL-Hmammi Trading Est. Riyadh. Riyadh, Saudi Arabia

ABSTRACT

Light-emitting diode (LED) is a promising semiconductor optoelectronic device, which has small size, long life, environmental protection and many other advantages. Due to its nanosecond time response of luminescence, LED can achieve high-speed modulation of information. Indoor LED lighting source is regarded as communication base station, through high frequency flashing of the lighting source to pass on information, downstream data link with a wireless transmission protocol complementary is provided and lighting and communication integration is implemented. In the aspect of electromagnetic radiation, communication efficiency and safety, it has a lot of advantages over radio frequency (RF), which is a new high-speed data transmission mode. In this paper, by using the advantage of short response time of LED, a visible light communication system based on On-Off Keying (OOK) modulation and demodulation technique is designed, which can improve lighting quality and adaptation to the environment without changing the lighting LED spectral components. By using software and hardware combination, video transmission between the two devices is complemented by optical communication. The prototype of the test platform is constructed, and then debugging and analyzing is conducted. The video transmission is further tested, and the feasibility of the scheme is verified, which meets expected goals. This system provides a method for information transmission and has theoretical and practical guidance for LED optical communication.

Keywords - Visible Light Communication; Video Transmission; Coding And Decoding; Communication Protocol; LED Lighting.

I. INTRODUCTION

With the development of society, the growing demand for green lighting, green communication and wireless communication become more prominent. For more secure transport protocol and higher transfer rates and more free mobile terminals, the visible light communication technology emerges at the right moment. Visible light communication (VLC) belongs to optical wireless communication (OWC). OWC uses visible light, infrared or ultraviolet wavelengths to transmit signals. The communication using visible light, which has the waveband of 390-750 nm, is commonly referred to as visible light communication, which is a new form of wireless communication [1].

Visible light is the part of the electromagnetic spectrum that can be felt by human eyes. If the frequency of the electromagnetic spectrum is in the order from low to high, they are radio waves, microwave-band, the terahertz radiation band, infrared, visible light, ultraviolet band, x-rays and gamma rays.

Scholars generally believe that the human eyes can feel wavelengths generally falling in the wavelength range from 390 nm to 700 nm corresponding to the frequency range between 430T Hz-790T Hz. Whitelight light-emitting diode (LED) has become a new generation of green lighting source with features such as small size, high efficiency, low power consumption, long life, environment protecting. Since LED has rapidresponse, being as a potential means of communication is promising [2]. Visible light communication makes use of the feature that LED can be modulated at high speed. Data are modulated on high speed switching LED lights, and the shading of the light or frequency represents "0" or "1", in order to transmit data signal [3]. In today's visual communication, orthogonal frequency division multiplexing (OFDM) or optical code division multiple access (OCDMA) encoding technology is employed. Special physical structure of the human eye makes our eyes have the persistence of vision effect, which is that after a stop at the light on the retina, vision remains for some time. For example, the AC main we use is 50Hz, so light is off 100 times every second, but the light flashing is not felt, which is the result of the persistence of vision effect. High-speed optical signal modulation frequencies are greater than 50Hz, and while LED transmits signal, changes of light cannot be detected by human eyes. In the communication process, LED light source can transmit signal, and can also be used as light sources, making full use of the energy, which has the feature of environment protecting. In this paper, hardware circuit of an optical communication system is designed, and low computer system is made, which can guarantee enough bandwidth to transmit. The software of the optical communication system is designed, and upper computer system is made, which can realize automation of the signal transmission. The main performance of the system is debugged and analyzed, the system performance is analyzed, and the measures of the optimizing system are proposed. In the aspect of the hardware, the LED light source is chosen, the design of the drive circuit of transmitting terminal and the design of the receiving terminal are decided according to the parameters of the LED, communication model is established, communication protocol is drawn up, and the whole system framework design is introduced in detail. In the aspect of the software, by using the software Microsoft Visual Basic (VB) 6.0, the upper computer test system is written, which can realize the automatic collection and transmission of video.

II. PRINCIPLE

A. Visible light communication system The system uses computer-generated video signal, by data conversion module, through the LED driver circuit, converted to signal that LED can transmit. The signal is sent out in the form of light. The receiver receives available signals by optical sensor, and the photoelectric sensors zoom and decode the received signal, then the signal is output to another computer. Figure 1 shows the operating principle of thesystem.

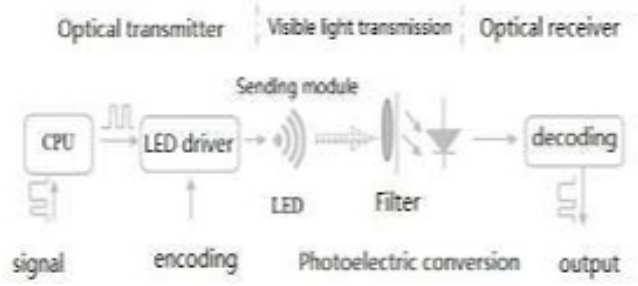

Fig. 1. The principle of the LED light communication [4].

Optical communication system has many basic linking modes, and Figure 2 shows a simple diagram of optical communication system. Due to the influence of various factors to be considered, optical transmission remains extremely challenging. In the indoor environment, the light will be subject to the reflecting of the ceilings, walls and other objects. In outdoor environment, duo to atmospheric environment, light will be scattered or absorbed. There is a classification that according to that transmitting equipment and receiving equipment are open or not. It can be divided into Line-of-sight link(LOS)andnon-LOSlink(NLOS).

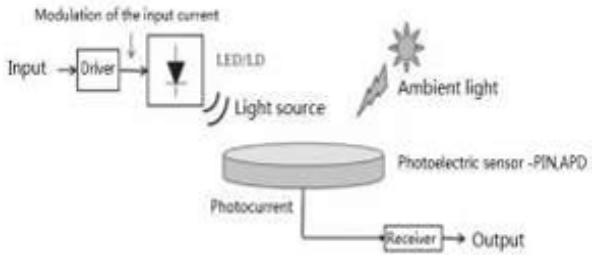

Fig. 2. Light communication system schematic [4].

Now a variety of optical communication link are used, and the following are four links [5]: direct LOS, indirect LOS, diffuse reflection link, tracking link. Some receive modes are a mixture of links listed above, and these methods are shown in Figure 3.

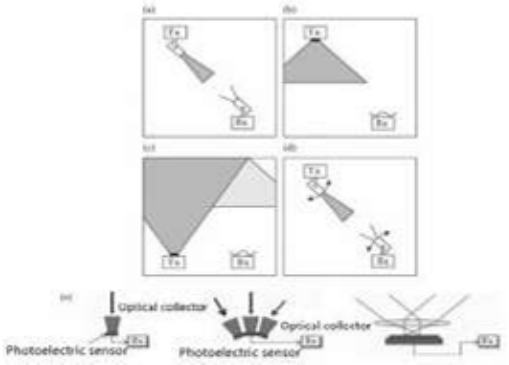

Fig. 3. Linking modes [4]: (a) direct LOS; (b) indirect LOS; (c) diffuse reflection link; (d) tracking link; (e) receive mode.

Diffuse reflection link and indirect LOS link have thelargest coverage, but while they increase the link robustness, they also introduce the multipath effect, resulting in significant intersymbol interference and pulse broadening. Tracking link is better, but still requires additional mechanical moving parts, and makes the system more complex, so it also should not be used. In this paper, the communications link used is based on point-to-point communication, so direct LOS channel link is employed. Using direct LOS has the advantage of that only receiving light from the transmitting equipment, the most power and the most ideal signal can be achieved, which can eliminate the multipath effects. In visible-light communication systems, communications efficiency and performance to a large extent depends on the modulation method. By using the feature of discrete value of digital signals, switch is used to control carrier signal and digital modulation can be achieved. This method is usually called keying, and keying methods are commonly used for keying carrier amplitude, frequency and phase shift, so three fundamental digital modulation methods can be achieved, known as amplitude shift keying

(ASK/OOK), frequency shift keying (FSK) and phase-shift keying (PSK) [6]. In addition, the common modes of modulation have pulse position modulation, modulation of orthogonal frequency division multiplexing (OFDM), sub-carrier modulation, Digital pulse interval modulation (DPIM), strong pulse modulation and double-pulse interval modulation and soon. ODFM technology has the advantages of high spectrum efficiency, which can reduce the multipath effect and inter symbol interference, but it has high algorithm complexity and its application is difficult. OOK modulation has low bandwidth requirements, and its hardware circuit is simple and it is easy to implement. During demodulating, as long as the light signals is directly detected having or not, signals from the sensors can be traced as "0" or"1".By comparing the modulation above, the OOK/off keying modulation method is adopted, and the expression is:

$$e_{OOK}(t)=\begin{cases} A\cos\omega_c t,[\text{sending "1" with probability } P] \\ 0,[\text{sending "1" with probability } (1-P)] \end{cases} \quad (1)$$

OOK is the most common LED optical transmission modulation, and it uses the light on or off to transmit data, which is in fact amplitude modulation. Its signalcode is divided into zero in coding (RZ) and non-zero encoding (NRZ). Sketch of the modulation is shown in Figure 4.

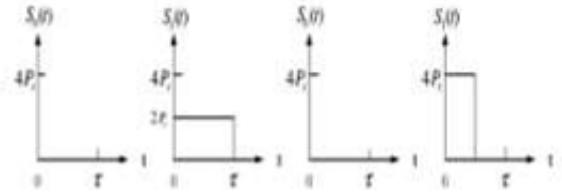

Fig. 4. (a) OOK NRZ; (b) OOK RZ of 50% duty cycle.

B. Processing of transmittal datastream

This communication system is based on transmissionmedium of visible light. The upper computer is required that video transmission between the two computers can be achieved. USB signal is converted to the serial signal by data signal conversion module, and serial signal by level shift is loaded on the LED, so the digital signal is converted into optical signal and optical video transmission between the two computers is realized. The upper computer software is divided into signal terminal and receive signal terminal. This program mainly uses the VB programming language and is developed onthe Windows platform, and data can be transferred stably by today's mainstreamcomputer.

Fig. 5. Sending interface of the upper computer.

The sender of the upper computer software of the system can useApplication Programming Interface (API) to get the computer camera data, and to regularly save video picture as picture format, which after decoding and compression are transmitted through the serial port. Before transmitting data, the software can choose the string number, baud rate, stop bits and data bits and parity bit. And the time interval of the transmit data, known as video frame rate, can be set, so that it can be adapted to different lower computer transmission rate. At the time of data transmission, which is transmitted in the form of packets, the size of packets to be sent is first calculated, and then the data are sent. Figure 5 shows the send-side software interface.

The lower computer can also set the serial communication, and it can also restore the received video signal data, and display it in the interface. After receiving the packet size to receive, it enters the state of the received data. After the data arereceived, they will be restored and displayed. Figure 6 shows the user interface of thereceiver.

Fig. 6. The receiver of the upper computer.

III. SYSTEM TESTING AND RESULT ANALYSIS

After the hardware system of thecommunication system isset up, tests are required in order to evaluate system performance. Different parameters are designed, input and output signal waveform are observed and measured, and the factors that affect the transmission quality can be concluded.

First, square-wave signal transmission performance is tested. The signal that is generated by signal generator isloaded on the circuit of the sending terminal to load the signal on the light source. Replacing computer with an oscilloscope, received signal and the source signal are displayed in the same oscilloscope, and their waveforms are compared, various parameters are analyzed and measured to test

effectiveness of thesignal.

A. Effect of light direction on communication system

The LED can be used as a lambertiansource in this paper, in line with the lambertianmodel, where the power of the LED P=1.12 W, the typical angle of field of view FOV=90°. In optical communicationlinks, DC gain h (0) is an important variable that represents the channel characteristics. Its formula is[7]:

$$H(0)=\begin{cases}\dfrac{(m+1)A}{2\pi d^2}\cos^m\phi T(\psi)g(\psi)\cos\psi, & 0\le\psi\le\psi \\ 0, & \psi>\psi\end{cases} \quad (2)$$

Where m is Lambert coefficient, A is the physical area of the area where receives light signals of the photoelectric sensor, d is the distance between transmitter and receiver, ψ is the angle of incidence of LED, ψc is FOV of the receiver radio detector, Ts (ψ) is the gain of optical filter, g (ψ) is the gain of concentrator.

Where g (ψ) formula is as follows [8]:

$$g(\psi)=\begin{cases}\dfrac{n^2}{\sin^2\psi}, & 0\le\psi\le\psi \\ 0, & \psi>\psi\end{cases} \quad (3)$$

Where nis the reflection coefficient. Received power Pr can be drawn from LED power:

$$P_r=H(0)P_t \quad (4)$$

According to the above theory, when the two points of the transmitter and the receiver are always in a straight line, the optical power is the maximum. When the deviation from the center line of the transmitter and the receiver is farther, the optical power is less. When the deviation angle is more than 30°, the output signal of the receiver is connected to the oscilloscope. In Figure 7, the upside waveform represents the original signal, and the downside one is for the received signal. We can see that when the angle of deviation increases, bit error rate increases, and data loss appears, which makes it impossiblefor the receiver to read the signals. Therefore, in this system, the light source should be aimed at the optical device of the receiving end.

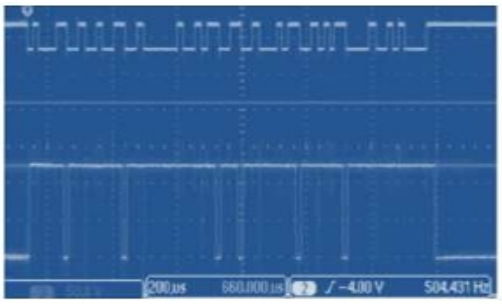

Fig. 7. Effect of different deviation angle on the communication system. (The upside waveform is sent by the transmitter, and downside one is receivedin the receiver)

B. Effect of receiving distance on communication system OOK modulation of light is used in this paper to transmit signal, and light shading represents data "1" or "0". Now it is assumed that the time of transmission of a square wave T is equal to the transmitted bits per second, and BER formula can be expressed as:

$$BER = Q\left(\sqrt{SNR}\right) \quad (5)$$

Where.

$$Q(x) = \frac{1}{\sqrt{2\pi}} \int_{x}^{\infty} e^{-\frac{y^2}{2}} dy \quad (6)$$

Figure 8 shows that when the receiver is on the center of light path of the transmitter, the BER of the system changes with distance. In theory, the greater the distance between sender and receiver, the higher the error rate is.

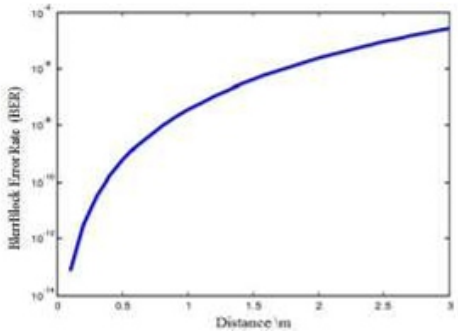

Fig. 8. The curve of the BER changing with distance [9].

Figure 9 shows the transmission signal waveforms when transmitter and receiver have the distance of 50 cm. The upside waveform represents the original signal, and the downside one is for the received signal. It shows that, when far apart, the signal the receiver receives is very weak, and if the signal is not enlarged, the receiver cannot tell the difference between high and low level. So, reasonable transport distance should be selected in order to avoid errors and misplacement of the communication.

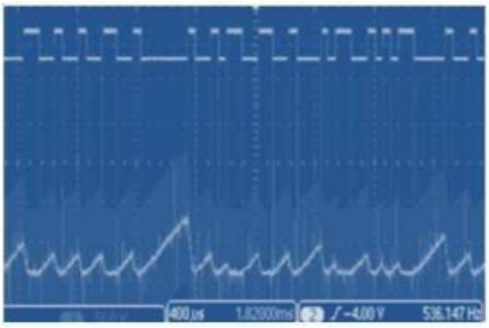

Fig. 9. The transmission signal waveform at the distance of 50 cm.

C. Effect of increasing optical devices on communication system In the experiment, it is found that if optical device lens is added on the sender and receiver to focus, the transmission distance can significantly increases, the quality of signals improves to meet information needs. Figure 10 shows the signal waveform when there is no optical device. Figure 11 shows the signal waveform after the lens is added. It can be seen by comparing that the signal in Figure 11 is better. So when setting up the system, the spotlight glass is installed at the transmitter or optical lens is installed in the optical sensor part of the receiver to enhance light effects and reduce the attenuation of optical power.

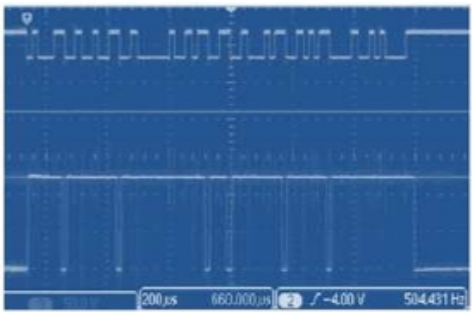

Fig. 10. The signal waveform when there is no optical device.

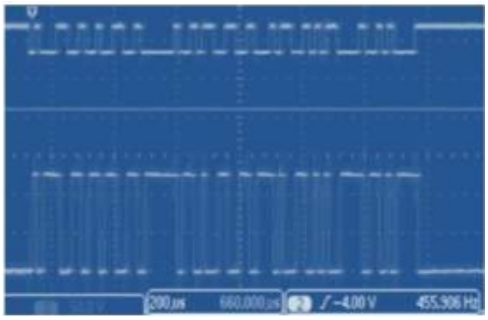

Fig. 11. The signal waveform after the lens is added.

D. Effect of transfer rate on communicationsystem

The waveform at 200K Hz is shown in the following figure. It can be seen that the output waveform in Figure 12 is an approximate square wave, which can accurately transmit signals, and there is no obvious distortion.

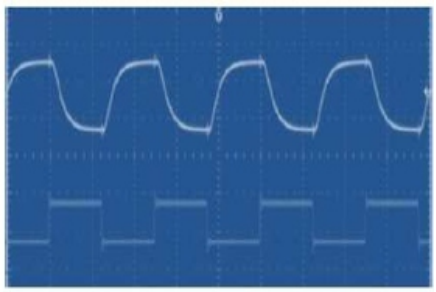

Fig. 12. The input and output waveform at 200K Hz.

Then the frequency is continuously increased. The frequency of the waveform in Figure 13 is 1.3 M Hz. The curve below is the input waveform, while the curve above is the output waveform. It can be seen in the picture that, the output waveform has become close to sinusoidal graphic, but it is possible to use an inverter or comparer to integer to get normal square waveform. When the frequency is increased from 1.3 M Hz, the waveform deforms, and cannot be recognized completely. Therefore, when the data are being transferred, they are more stable when the rate is not higher than 1M Hz.

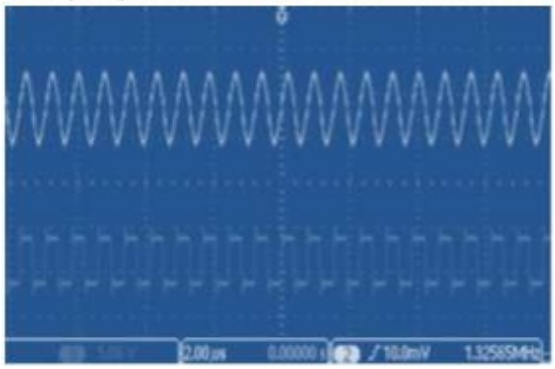

Fig. 13. The input and output waveform at 1.3M Hz.

E. Test and analysis of actual data

The receiving module and dispatching module are respectively connected to two computers, and the whole system is debugged by using serial debugging assistant, and is tested by sending a string of characters. Figure 14 shows the contrast before and after a TTL signal waveform is transmitted. The blue wave form is the original signal, the green is an amplifying signal by drive, and the purple is the signal received by amplifying and filtering. In the picture, it can be seen that the waveform restored from the receiver has no obvious distortion and deformation compared with the original waveform.

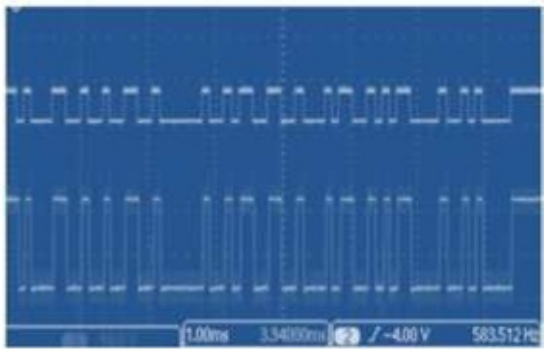

Fig. 14. The contrast before and after a TTL signal waveform is transmitted.

Tests are conducted through the hardware and software platforms, and the debugging results are observed in order to test the performance of the system. The image appears in the interface of the receiving end, as shown in Figure 6. In Figure 15, the light from the LED lamp is optical signal converted from one computer, and the circuit of the receiving end is collecting the optical signal to convert and transmit it to the other computer. It can be seen that combining upper and lower computer real-time transmission of video signal can be realized. Since this work is just a communication model, there are still a lot of problems. During the testing, the video signal is not smooth, the signal is

occasionally lost, and the screen jitter occurs. They are caused by that the signal processing part of the hardware system may be unstable at high frequencies and there is background noise and these issues need further analysis. Through the test, this communication system needs to be kept within 15 cm to ensure real time signal transmission. In theory, by improving the light source, replacing with high power LED and matching drive circuit, transmission distance and signal coverage can effectively increase. Thus, optical communication can be applied to more devices, which provides a new means of communication for wireless connection and information sharing between multiple terminals.

Fig.15. Transmission of signal based on LED lighting.

CONCLUSION

In this paper, by using the feature of short response time of LED, a visible-light communication system based on OOK modulation and demodulation techniques is designed, and a communication system prototype is built, which realizes video real-time transmission. The main work of this paper can be summarized as follows:

1) Based on existing theory, LED optical communication system prototype is designed and built. Using the LED from the market, an appropriate solution is designed and components are selected. Data conversion circuits, LED driver circuit, the receiver circuit, amplifier and filter modules are set up, the receiving and sending terminal of the optical communication system is completed.

2) In a dark room environment, by using a waveform generator, a square-wave signal is produced and is loaded on the LED driver circuit, converting the square wave signal to optical signal, signal reception result is tested after the receiving end is connected to the oscilloscope, and system performance and the causes of limitation of rate are analyzed. The maximum sending speed and transmission distance are tested.

3) Using VB programming language, the upper computer of the video transmitter and the receiver is realized. The automatic sending and decoding of video ensure stable transmission of signals in LED light communication system. Through theory analysis, integrating the experiment debugging results, several main reasons that effect signal transmission performance can be drawn: (1) increasing distance leads to quickly attenuation of the received signal of received end; (2) the response frequency and bandwidth of LED devices and received devices limit its rate; (3) background noise during transmission process increases with the distance increasing; (4) brightness and transmission distance can effectively increase by using spotlight to concentrate the emissive light.

REFERENCES

[1] Tanaka Y, Haruyama S, Nakagawa M. "Wireless optical transmissions with white colored LED for wireless home links". The 11th IEEE International Symposium on IEEE, 2000, pp. 1325-1329.

[2] IEEE Standard Association. "IEEE Std. for Local and metropolitan area networks-Part 15.7: Short-Rang Wireless Optical Communication Using Visible Light," IEEE Computer Society, 2011.

[3] Wu F M, Lin C T, Wei C C, "1.1-Gb/s white-LED-based visible light communication employing carrier-less amplitude and phase modulation," Photonics Technology Letters on IEEE, vol. 24, pp. 1730- 1732, 2012.

[4] Nan Chi, LED Visible Light Communication Technologies (in Chinese) [M], Tsinghua University Press,2015.

[5] GhassemlooyZ, Popoola W, Rajbhandari S, Optical wireless communications: system and channel modelling with Matlab, CRC Press, 2012.

[6] Jian Song, Zhixing Yang, Jun Wang, Digital Terrestrial Television Broadcasting:Technology and System, 1rd ed., Wiley-IEEE Press, 2015, pp. 456.

[7] Barry J R, "Wireless infrared communications," Springer, 1994

[8] Kahn J M, Barry J R, "Wireless infrared communications," Proceedings of the IEEE, vol. 85, pp: 265-298,1997.

[9] He Y, Ding L, Gong Y, et al. Real-time Audio & Video Transmission System Based on Visible Light Communication[J]. Optics & Photonics Journal, 2013, 03(02):153-157.

ISSN :2320-2084

AUTOMATIC LIGHT INTENSITY CONTROLLING USING IOT

1ANUPSURAHONNE, 2AMOGHALOKESH, 3ADITHYA N SIMHA, 4ARJUNA C REDDY
B N M Institute of Technology, Electronics and Communication Department
Bangalore – 560070, India.

ABSTRACT

One of the significant issues looked by the present reality is Energy Crisis. As indicated by Central Electricity Board, a leading group of India, around 6.7 TWh is devoured in broad daylight lighting, costing more than $500M every year[1]. Internet of Things (IoT) is an ideal answer for this issue. IoT has empowered us to control and screen electronic gadgets remotely through the web. This paper centers around how the power devoured by the road lights can be spared by ceaselessly observing the encompassing brilliance and changing the light force likewise utilizing the MQTT convention. This paper exhibits how such a setup can be executed for an outside road light and for an indoor lighting arrangement of a building.

Keywords- IoT, Street Lights, MQTT, Ameba RTL8195.

1 INTRODUCTION

India is a standout amongst the most populated nations on the planet. There are in excess of 35 million road lights spread the nation over. Dominant parts of these lights are sodium vapor lights that devoura gigantic measure of intensity[2]. Different activities are being done by the legislature of India to lessen the measure of intensity devoured by these road lights. One of the case for such an activity is, to the point that a road lighting framework that consequently turns off at dawn and switches on at dusk is created by Municipal Corporation of that state. This framework likewise encourages for programmed vitality metering subsequently wiping out the need of manual meter perusing[3]. This paper proposes a framework where the power devoured by the road lights are decreased consequently by altering the light force contingent upon the encompassing light force.

This framework can likewise be utilized to turn in the city lights at dawn and kill at dusk. Rather than controlling the road lights dependent on the nearby time this paper centers around controlling them dependent on the encompassing light power. At the point when there is a startling change in the climate this framework guarantees that road lights are killed when there is adequate daylight and turned on when there is inadequate daylight. To keep up a record on encompassing light power we utilize an idea called as brilliant gadgets where road light utilize Wireless association that offers IoT availability. IoT is one of the real innovation used to understand a shrewd city. The Internet of Things (IoT) is arrange where different savvy gadgets are entomb associated and furthermore speak with one another over the web. Smart gadgets are equipped for interfacing with the web. IOT comprises of such various brilliant gadgets which are fit for associating with the web. These gadgets can send information by getting from different sensors and can likewise get information from other smart gadgets by means of web. This strategy for correspondence between the smart gadgets is called as machine to machine correspondence.

Despite the fact that clients can associate with these gadgets to screen, control and change them, their mediation isn't important as they can work autonomously. IoT produces an enormous measure of Information, this significantly troubles the specific framework of the Web[4].

These huge lump of information are ceaselessly traded between the smart gadgets. In this manner, there is a requirement for an online stage like distributed storage where expansive piece of information can be put away. Information handling includes information obtaining, stockpiling and analysis[5]. Here we have utilized adafruit.io as a stage which is particularly intended for understudies that permits straightforward information association. Customer libraries which are incorporated into IO take a shot at different conventions like MQTT and Programming interface[6] . MQTT is the convention utilized here to actualize this venture. MQTT is extended as Message Queuing Telemetry Transport. This convention is utilized to send and get information.

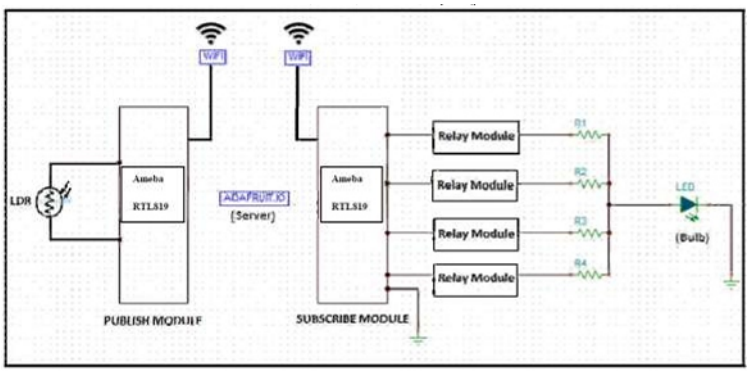

Fig.1 An Overview of Automatic Streetlight Controller

II. HARDWARE IMPLEMENTATION AND WORKING

Considering large scale implementation, several aspects are to be kept in mind before designing any system such as this. This process is not same as designing a software. In software design, we just consider how quick the system responds, but in hardware implementation, along with speed of operation, the cost, power consumption and the efficiency plays a major role. In order to improve the working of any system, we have to decide upon a controller that has a good efficiency and reduces the power consumed. Hence we need to select a low power micro-controller. In the proposed system, since it is dependent on the internet, we need to consider a controller which comes with an internal Wi-Fi module or supports the working of an external Wi-Fi module. To reduce the physical complexity of the system, it is preferred to choose a controller which has an inbuilt Wi-Fi system. Keeping all these features in mind we have chosen Ameba RTL8195 as our microcontroller. There are two sets of devices or blocks in this implementation, we have a publisher and a subscriber. A publisher block is the one which reads the intensity of light present in the surrounding and uploads the data onto the server. A subscriber block takes this data from the server, processes it and performs necessary actions for different values of the light intensity. Hence, we need 2 controllers, one at publisher side and the other at the subscriber side, an LDR to convert the light intensity into electrical signal and relay switches to control the current flow into the street-light. The different hardware parts involved in this system are described below.

A. Ameba RTL8195

Ameba RTL8195 is an ARM Cortex M3 based microcontroller which was designed to support applications related to the internet of things. It is a 32 bit microcontroller given by ARM Cortex M3. It can support clock frequencies as high as 166MHz. Along with this, it has an inbuilt 1MB flash memory, 1MB ROM, 512 kB SRAM along with 2MB SDRAM. It supports 10 Ethernet and 100 Ethernet interfaces. The main feature of this microcontroller is that it has an inbuilt Wi-Fi module which is designed to support communication with the internet. The integrated module is the standard IEEE 802.11b/g/n. The Wi-Fi communication is done through the Wi-Fi antenna, which is a high gain Dipole antenna. This is basically an antenna which is printed on the board. Ameba RTL8195 hasacapacity to support around 30 GPIO ports. We program this microcontroller on a pc using the standard driver provided by the company which is Arm MBED CMSIS DAP driver, in which we have to install the Arduino IDE to program this controller. This microcontroller has few low power consumption modes, which help the user to reduce the power consumption by the controller. It has "sleep" and "deep-sleep" modes of operation in low power mode. During its normal modes of operations, it takes it power of 3.3v from the micro USB connected to the PC.

There are two working steps as mentioned already, which we need to concentrate on:

1) Publish block- here, we use an LDR to constantly take the readings of the light intensity of the surroundings. This is an analog value, which needs to be converted into a digital value. This is done using inbuilt ADC block present in the RTL8195 microcontroller. This converted digital values is now published onto the server for use by other devices.

2) Subscribe block- in this block, we extract the live data that was published onto the server by the publish block and process it. Depending on the intensity values, we fix upon few thresholds or ranges. In our model, there are 4 such cases. Depending on the range in which the value of intensity falls, we drive the bulb with different values of currents. Here comparison is done based on the programmed ranges.

This module compares the intensity with each of the range and depending on which range this value is present in, the microcontroller select the respective relay switch and hence drives the load, which in our case is the street light. If the intensity of the surrounding light is high, the controller switches off the street light automatically.

B. Light Dependent Resistor (LDR)

Light dependent resistor is a semiconductor device whose resistance value varies with the light intensity falling on in, in other words it is a light controlled device. An LDR shows the principle of photoconductivity. This is a phenomenon where the conductivity of the device increases with increase in the light incident on it or it can also be referred as decrease in resistance with increase in light intensity. This phenomenon of photoconductivity is made use of, tocontinuously sense the light and convert it into electric energy or voltage. This voltage is considered as analog input to the microcontroller, which is then taken forward as required by us.

C. Analog to Digital Converter (ADC)

Analog to Digital converters(ADC) are the most commondevices that are used in almost all the communication processes, where it is required for the analog signals to be converted into digital signals for the sake of processing. Ameba RTL8195 has a builtin 12 bit precision ADC with two channels. The ADC is been operated by utilising the battery voltage of the RTL8195 and hence helps in measuring on board as well as external voltage. The range of measurement is between 0V-3.3V[9].

Therefore the minimum voltage that can be measured or the minimum difference in voltage that can bemeasured, using this ADC is about 8mV. Since it is a 12bit ADC, 0 corresponds to the least input voltage and 4096 corresponds to the highest input voltage and hence the range issaid to be 0 to 4096.

D. Message Queuing Telemetry Transport (MQTT)

The first version of MQTT (Message Queuing Telemetry Transport) was authored by Andy Stanford-Clark of IBM and Arlen Nipper of Cirrus Link in 1999 which later on has gone through a lot of evolution. MQTT is a simple protocol of IOS Standard and works on top of TCP/IP protocol[10]. It was developed to work on two modules out of which one is the publisher module and the other is the subscriber module. Basically MQTT consists of a client, which is either the publisher module that publishes the information or the subscriber module that subscribes the information and the server (also called as broker) to which or from which the client gains or publishes its information, this was developed mainly for small codes and communication that involves lesser complexity and message queuing[11]. In our case we are making use of the server adafruit.io which will act as the broker to the clients (publisher and subscriber modules). MQTT-SN is another variation of MQTT and its transportation is based on Bluetooth and not TCP/IP protocol.

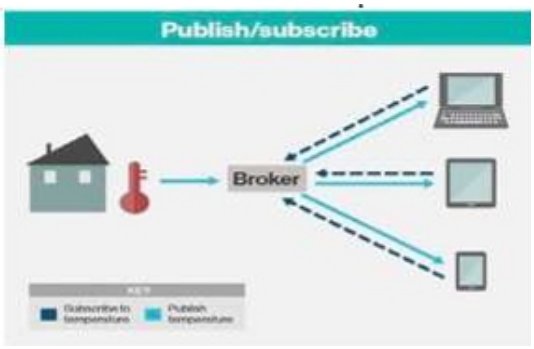

Fig2. MQTT Protocol

III. SOFTWARE DESIGN

With a transition to “smart” devices, IoT plays a significant part in interconnecting them. The functionality of these smart devices decreases drastically when they are not connected to the internet. It is vital to design a software program that is compatible with the hardware. Only by combining both the hardware and software technology, a fully functional system can be obtained.

MQTT was developed as a part of OASIS in 1999. The benefits of using MQTT protocol over any other standard protocols like HTTP is that MQTT ensures high delivery rate and is also lightweight because it operates in a low bandwidth and has low power footprints[12]. The Ameba RTL8195 microcontroller has been programmed using the Aurdino IDE. The Aurdino integrated development environment (IDE) is a cross-platform application that can be used for programming microcontrollers. The Aurdino IDE supports the languages C and C++. The Aurdino IDE consists of many library functions which provides several common input and output procedures. The flowcharts for the publisher module and the subscriber module according to which the program was written for the prototype was written is shown below.

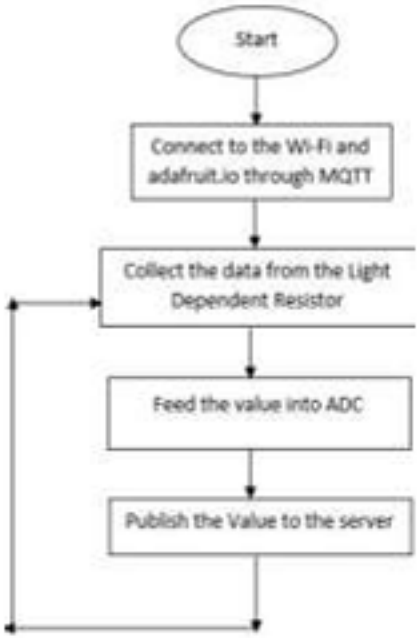

Fig 3.Flowchart for publisher module

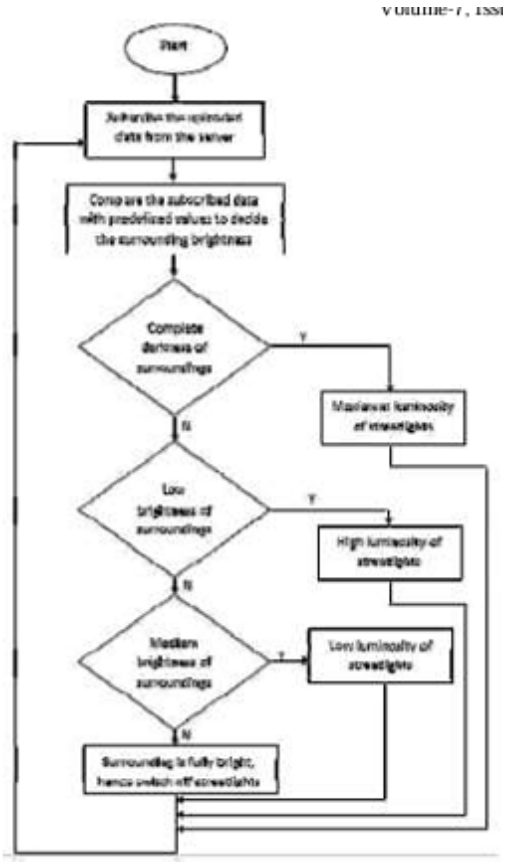

Fig 4. Flowchart for subscriber program

CONCLUSION AND FUTURE WORK

With a developing enthusiasm towards smarter urban communities and a requirement for a greener situation, programmed streetlight controller can be realized soon. The paper proposes a straightforward model which depends on IoT design. The shrewd city

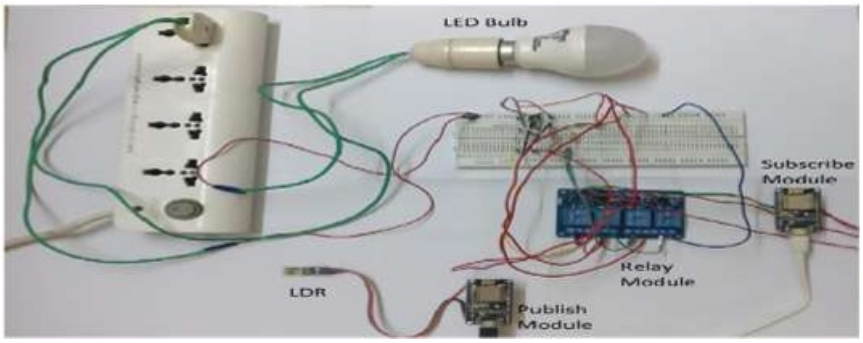

Fig 5. A prototype of automatic light controller.

REFERENCES

[1] Alissa Johnson, AmolPhadke and Stephane Energy Savings Potentialfor India.
[2] Environmental Energy TechnologiesDivision February 2014 Devavrat Kulkarni, Smart Cities:
[3] Optimize Street Lighting in India,Maven Systems Pvt.Ltd.
Street Lighting in Newspaper-TheHindu-MARCH-10-2010, http://www.thehindu.com/todays-paper/tp-national/tpnewdelhi/mcd-launches-automatic street lights systems /article15999794.ECE.
[4] Bernadette Johnson ,How the Internet of Things Works
[5] Mansi H Shah; Shreya P Shah; Prof.NidhiBarot :
[6] Big Data Concernwith Web Applications
[7] https://learn.adafruit.com https://www.seeedstudio.com/Ameba-RTL8195-Arduino
[8] https://www.amebaiot.com/en/ameba-arduino-getting started
[9] https://www.amebaiot.com/en/ameba-arduino-adcvoltmeter/
ttps://en.m.wikipedia.org/wiki/MQTT
[10] https://en.m.wikipedia.org/wiki/MQTT
[11] https://internetofthingsagenda.techtarget.com/definition/M
[12] Hansa Lysander Manohar, T. ReubanGnanaAsir : Data ConsumptionPattern of MQTT Protocol for IoT Applications
[13] Nabil Ouerhani, NuriaPazos, Marco Aeberli, Michael Muller : IoT-Based Dynamic Street Light Control for Smart Cities Use Cases ss

ISSN :2320-2084

AUTOMATIC SOLAR TRACKER USING MSP430 MICROCONTROLLER

1KARTHIK S MURTHY, 2PARULHERUR, 3ADITHYA B R, 4HARSHITA LOKESH

B N M Institute of Technology, Electronics and Communication Department
Bangalore-560070, India

ABSTRACT

Renewable resource is a natural resource which reduces the resource depletion caused by excessive usage and consumption. It forms the major part in the ecosphere. Some of them are sun, fresh water, wind etc. Out of all these solar energy tops the list, since it is more efficient and can be easily converted to other forms. We can't expect maximum power from a stationary panel. In order to maximize the output power, the solar panels must be in phase with the sun. By using panels that can be rotated along an axis, with respect to the position of the sun, we can improve the efficiency of conversion by at least 40-50%. This paper proposes exactly the same idea where in a solar tracking system is designed with the help of MSP430 micro controller which is programmed to track the sunlight and to make sure that the solar panel is made to receive a great volume of sunlight and help in generating a considerably large amount of power.

Keywords- Renewable Resource, Solar Energy, Stepper Motor, Solar Panel, MSP430

1 INTRODUCTION

Energy Crisis is one of the major global problems. The demand for energy is increasing rapidly and this in-turn makes us highly dependent on fossil fuels and other non-renewable resources. Though they seem to be available in abundant, we will eventually exhaust them. It is high time we tend to renewable resources to satisfy our growing demands. Solar Power and Hydrogen gas are the main sources when we think of clean and renewable power. Solar energy is literally available for free by the sun; we just have to employ our solar panel and other technology to capture and utilize it to produce electrical energy for our needs. There is no emission of gases or release of any toxic waste as a result of conversion of solar energy to electrical energy, so it will be the best alternative for fossil fuels if we can improve our technology and minimize the cost of production of solar panels.

This paper proposes a prototype using an already existing solar panel technology to change the orientation of the solar panels according to the direction of the sun to increase its efficiency. Why do you think sun flowers always point towards the direction of the sun? In simple words, it is to increase its productivity. The same concept is used in this prototype where the solar panel changes direction so that the sunrays are always perpendicular to the panel [1]. Having a tracking solar panel is supposed to have 25% to 45% more efficiency when compared to the stationary ones. The hurdle in designing this panel is to make it efficient enough to utilize less power to track the sun and also produce more power by tracking the sun. Hence, care has to be taken that the module accurately tracks the sun based on the geographical location of the panel and always keeps it perpendicular to the sun in that location [2].

The inclination of the earth's axis and the geographical location pay an important role in the uration of daytime and night-time. Hence care has to be taken in the initial installation angle and timing of the motor rotation of the solar panel. This paper, introduces a solar tracker where MSP430 is used as the core microcontroller. A stepper motor is also used along with the motor driver (ULN2003A). During cloudy days or during rainy seasons, it is hard to track the sun using a Light Dependent Resistor (LDR) and the whole systems fails if there isn't sufficient light to trigger the LDR. Therefore, it is more convenient to rotate the panel at specific intervals during the day and revert it back to the original position at night. The microcontroller is interfaced with the stepper motor and it is programmed to rotate the panel at regular intervals which corresponds to the direction of the sun. Care has to be taken in programming the microcontroller to the specific geographical location and also the initial installation of the panel at the appropriate angles so that the panel is always pointing straight towards the sun.

II. HARDWARE IMPLEMENTATION

A. MSP430 Microcontroller The MSP430 belongs to the family of microcontrollers developed by Texas Instruments. There are six generations of this microcontroller starting from MSP430x1xx to MSP430x6xx and they have multiple families of microcontrollers [4]. This allows us to choose the microcontroller required for the specific application. MSP430 has 6 different low power modes and they are used for low power embedded devices [5]. The main features of Msp430 are:

1) Low power
2) Low cost
3) High Performance

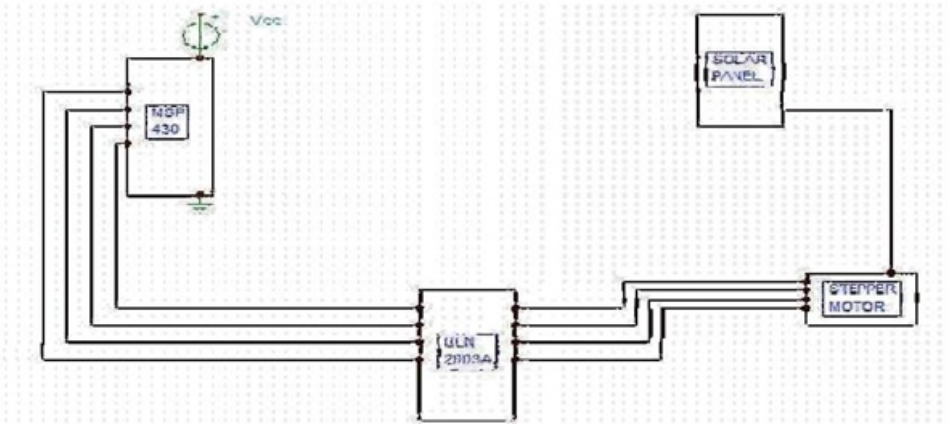

Fig.1 An overview of Solar tracking system

B. Solar panel

Solar Panel is device which absorbs the solar energy and converts this solar energy into electrical energy. They are made up of set of photovoltaic cells (PV cells). These PV cells are made up of silicon and are also called as solar cells. These solar cells are used to generate electrical energy by photovoltaic effect [11]. The solar cells are arranged together to form modules which are mounted on a structure. The generated electrical energy has to be stored since the energy generated is small and we use batteries to store the energy generated. The average efficiency of solar panels lie between 10% to 18%. Some of the advantages of solar panels are as follows:

1) Wear and tear are very less.
2) Helps to reduce global warming.

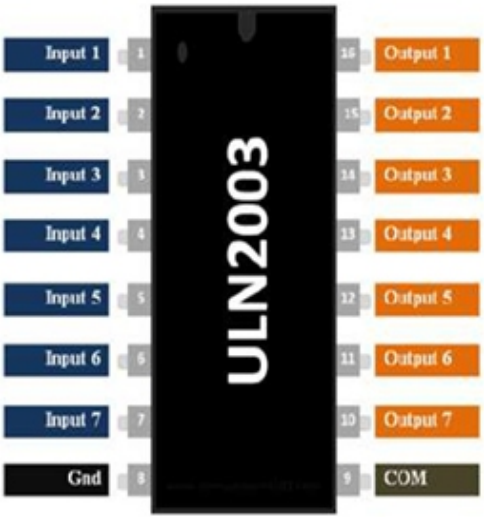

Fig.2 Pin diagram of ULN2003A

C. ULN2003A MOTOR DRIVER:

This motor driver is an array of transistors. The transistors used here are Darlington transistors of high voltage and high current. It consists of seven pairs have to connected in parallel to obtain high current. The UNL motor drivers have been categorized into different families and ULN2033A belongs to the family of ULN200x series. ULN2003A is designed to withstand a current of 500mA but it can withstand a current up to 600mA. Each device also contains a supervision diode to dissipate voltage spikes while driving inductive loads [12] The features and applications of ULN2003A are as follows:

Features: 500mA collector current, Output- 50V, compatible with different types of logics, example: TTL and 5 V CMOS.

Applications: Used for interfacing with Stepper motors, Logic buffers, Line drivers,Relays, Lamp and LED displays.

D.STEPPER MOTOR:

We know that a DC motor has two carbon brushes which supports the motoring action. Stepper motor is something similar to a DC motor, except that it does not have any brushes which aresupporting the rotations. It is made up of windings, which are electromagnets. Several suchelectromagnets put together form the stepper motor. There are two main types of windings, statorwindings and rotor windings. Rotor windings is a rotating shaft, whose rotations is based on the electric potentialapplied to stator windings. This shaft is also known as a gear. This gear is made up of a number of magnets which we call as teeth. In a stepper motor, there issomething called the step angle. This is the angle by which the rotor changes its alignment betweentwo consecutive excitations of the stator teeth. If there are 60 stator teeth, then the minimum stepangle of that stepper motor will be 6 degree. The working of the stepper motor shows that the rotor movesin integral steps and not continuously like a DC motor. Hence the name stepper motor.

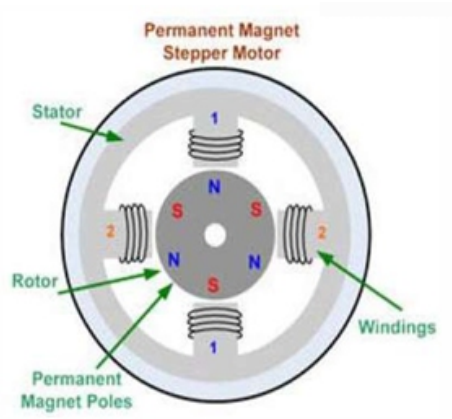

Fig.3 Inside of a stepper motor

Fig.5 Prototype of a solar tracker system for demonstration

III. PROGRAMMING METHODOLOGY AND WORKING

We have used CC studio (Code composer) studio which is an integrated development environment consisting of several tools for developing and debugging embedded system applications which enables the software to run on the firmware. We have utilised embedded C to program the microcontroller because of its compatibility with TI microcontrollers (MSP430). In MSP430, we use pins 1.1,1.2,1.3 and 1.4 as output pins which is used to supply power to the stepper motor used. We have utilised a stepper motor as it helps us to rotate our panel in terms of predefined steps and predefined step angles. However, since the output current of MSP430 is in terms of milli amperes which is insufficient to drive the motor we have utilised a motor driver ULN2003A.This step up the output current and voltage such that the motor receives sufficient power for it to be driven.

We require four input signals to excite the four windings of the stepper motor are connected to the four output pins of MSP430 the motor driver's (ULN2003A) input pins. The MSP430 is powered up from pin Vcc. The output pins of ULN2003A is connected to the 4 input windings of the stepper motor; say windings A, B, C, D. Utilising the internal clock of MSP430 we have programmed the microcontroller such that it outputs power every hour because of which the stepper motor rotates every hour only. This has been effectively programmed such that the delay between two consecutive steps of the stepper motor must amount to 60 minutes. the motor is set to rotate by an angle 7.5 degree thus completing 180 degrees in the pre-anticipated time interval. From dawn at around 6am in the morning, the stepper motor begins its rotation and rotates till about 6pm in the evening. Thus, the motor is able to rotate the panel from east direction in the morning to west direction in the

evening. Thus, the motor is able to rotate the panel from east direction in the morning to west direction in the afternoon thus harvesting maximum amount of solar energy. After the sun sets, that is after 6pm the motor is programmed such that it returns to its initial position and is ready for the next day's process all over again. The initial installation of the panel is done by taking into considerations the geographic coordinates of the panel and must be henceforth placed at an appropriate angle. This project thus when implemented is capable of increasing the power generated by the solar panels and harvest the sun's energy as much as possible albeit the motor and the control system involved consumes some portion of the power generated. The flow chart depicting the above working is shown below in Fig 6.

CONCLUSION AND FUTURE WORK

In the proposed paper we are trying to build a universal solar tracking device. Here we try to maximize the output of solar panel by making it align with the sun depending on the position, by pointing the panel in the direction of maximum light intensity, which is demonstrated using a working model. The proposed model could track the movement of sun with the help of micro-controller and stepper motor. Here we make use of MSP430 micro-controller since it is more efficient irrespective of the weather condition or the geographical location. One of the advantages of this system is that even if the weather is cloudy or even if it is raining the position of the sun does not change and hence the sunlight that is available is still received by the solar panel. The proposed system is just a prototype of the main model, hence there are some limitations. For practical purpose we need bigger stepper motor with gear box Here, we have considered only one-dimensional rotation of the panel. Though there are a few limitations in the hardware in the initial set up, there is room for more improvement of design methodology in the future.

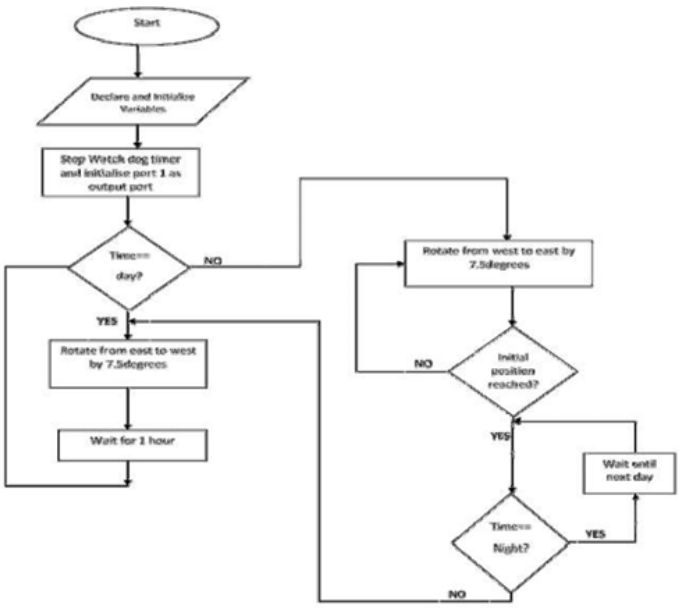

Fig.6 Flow Chart

ACKNOWLEDGMENT

This project was supported by Innovative Project Labs of BNMIT Bengaluru, India.We express our gratitude towards our beloved lecturer Mrs. Chaitra Nagaraj, Assistant Professor, BNMIT for providing us stupendous support and assistance. We also thank our department for providing the necessary lab assistance and constant encouragement in completing this paper.

REFERENCES

[1] A.T. Kearney and ESTELA (European Solar Thermal Electricity Association) (2010), Solar Thermal Electricity 2025, A.T. Kearney GmbH, Düsseldorf, Germany, www.estelasolar.eu.
[2] http://www.rsc.org/journals-books-databases/about journals/energy-environmental-science/
[3] http://energyinformative.org
[4] Texas, Instruments. "ULN2003A Datasheet" (PDF).
[5] Embedded Systems Design with the Texas Instruments
[6] MSP432 32-bit Processor Mitchell A.Thornton, Southern Methodist University
[7] Reduced Instruction Set Computers - David A. Patterson
[8] Computer Science Division, University of California, Berkeley, CA
[9] Robot Builder's Bonzana-Gordon McComb McGraw Hill,Fourth Edition
http://www.yankong.com
[10] SolarCity Unveils 'World's Most Efficient' Panel, by Justin Worland October 2, 2015,Time
"Milestone in solar cell efficiency achieved New record for unfocused sunlight edges closer to theoretic
[11] limits",May 17,2016,University of South Wales
www.investopedia.com/terms/r/renewable_resource.asp

Instructions for Authors

Essentials for Publishing in this Journal

1 Submitted articles should not have been previously published or be currently under consideration for publication elsewhere.

2 Conference papers may only be submitted if the paper has been completely re-written (taken to mean more than 50%) and the author has cleared any necessary permission with the copyright owner if it has been previously copyrighted.

3 All our articles are refereed through a double-blind process.

4 All authors must declare they have read and agreed to the content of the submitted article and must sign a declaration correspond to the originality of the article.

Submission Process

All articles for this journal must be submitted using our online submissions system. http://enrichedpub.com/ . Please use the Submit Your Article link in the Author Service area.

Manuscript Guidelines

The instructions to authors about the article preparation for publication in the Manuscripts are submitted online, through the e-Ur (Electronic editing) system, developed by **Enriched Publications Pvt. Ltd**. The article should contain the abstract with keywords, introduction, body, conclusion, references and the summary in English language (without heading and subheading enumeration). The article length should not exceed 16 pages of A4 paper format.

Title

The title should be informative. It is in both Journal's and author's best interest to use terms suitable. For indexing and word search. If there are no such terms in the title, the author is strongly advised to add a subtitle. The title should be given in English as well. The titles precede the abstract and the summary in an appropriate language.

Letterhead Title

The letterhead title is given at a top of each page for easier identification of article copies in an Electronic form in particular. It contains the author's surname and first name initial .article title, journal title and collation (year, volume, and issue, first and last page). The journal and article titles can be given in a shortened form.

Author's Name

Full name(s) of author(s) should be used. It is advisable to give the middle initial. Names are given in their original form.

Contact Details

The postal address or the e-mail address of the author (usually of the first one if there are more Authors) is given in the footnote at the bottom of the first page.

Type of Articles

Classification of articles is a duty of the editorial staff and is of special importance. Referees and the members of the editorial staff, or section editors, can propose a category, but the editor-in-chief has the sole responsibility for their classification. Journal articles are classified as follows:

Scientific articles:

1. Original scientific paper (giving the previously unpublished results of the author's own research based on management methods).

2. Survey paper (giving an original, detailed and critical view of a research problem or an area to which the author has made a contribution visible through his self-citation);

3. Short or preliminary communication (original management paper of full format but of a smaller extent or of a preliminary character);

4. Scientific critique or forum (discussion on a particular scientific topic, based exclusively on management argumentation) and commentaries. Exceptionally, in particular areas, a scientific paper in the Journal can be in a form of a monograph or a critical edition of scientific data (historical, archival, lexicographic, bibliographic, data survey, etc.) which were unknown or hardly accessible for scientific research.

Professional articles:

1. Professional paper (contribution offering experience useful for improvement of professional practice but not necessarily based on scientific methods);
2. Informative contribution (editorial, commentary, etc.);
3. Review (of a book, software, case study, scientific event, etc.)

Language

The article should be in English. The grammar and style of the article should be of good quality. The systematized text should be without abbreviations (except standard ones). All measurements must be in SI units. The sequence of formulae is denoted in Arabic numerals in parentheses on the right-hand side.

Abstract and Summary

An abstract is a concise informative presentation of the article content for fast and accurate Evaluation of its relevance. It is both in the Editorial Office's and the author's best interest for an abstract to contain terms often used for indexing and article search. The abstract describes the purpose of the study and the methods, outlines the findings and state the conclusions. A 100- to 250-Word abstract should be placed between the title and the keywords with the body text to follow. Besides an abstract are advised to have a summary in English, at the end of the article, after the Reference list. The summary should be structured and long up to 1/10 of the article length (it is more extensive than the abstract).

Keywords

Keywords are terms or phrases showing adequately the article content for indexing and search purposes. They should be allocated heaving in mind widely accepted international sources (index, dictionary or thesaurus), such as the Web of Science keyword list for science in general. The higher their usage frequency is the better. Up to 10 keywords immediately follow the abstract and the summary, in respective languages.

Acknowledgements

The name and the number of the project or programmed within which the article was realized is given in a separate note at the bottom of the first page together with the name of the institution which financially supported the project or programmed.

Tables and Illustrations

All the captions should be in the original language as well as in English, together with the texts in illustrations if possible. Tables are typed in the same style as the text and are denoted by numerals at the top. Photographs and drawings, placed appropriately in the text, should be clear, precise and suitable for reproduction. Drawings should be created in Word or Corel.

Citation in the Text

Citation in the text must be uniform. When citing references in the text, use the reference number set in square brackets from the Reference list at the end of the article.

Footnotes

Footnotes are given at the bottom of the page with the text they refer to. They can contain less relevant details, additional explanations or used sources (e.g. scientific material, manuals). They cannot replace the cited literature.
The article should be accompanied with a cover letter with the information about the author(s): surname, middle initial, first name, and citizen personal number, rank, title, e-mail address, and affiliation address, home address including municipality, phone number in the office and at home (or a mobile phone number). The cover letter should state the type of the article and tell which illustrations are original and which are not.

Note