

Design and Implementation of FPGA based Automatic Lecture Recording System

Arbab Waheed Ahmad ,Heekwon Yang, Gul Shahzad, Chankil Lee

Electronics and Communication Engineering department, Hanyang University, South Korea

arbab@hanyang.ac.kr, hkyang77@hanyang.ac.kr , gshahzad@gmail.com, cklee@hanyang.ac.kr

Abstract— Tele-teaching and distance-learning concept is getting much consideration these days since it poses easy access and availability of well-known instructors' lectures and presentations. In relation to video lectures, one of the utmost important concerns is professional video recording. Video recording inside lecture halls requires experienced camera-work professionals, who can record video lecture in an eye-catching way that keep the viewer concentration. To eliminate the overhead of expensive camera-work professionals, recently, image recognition algorithms combined with camera controllers make automatic lecture recording possible. In this article, we present real time implementation of the field programmable gate arrays (FPGA) based automatic lecture recording system. The system comprises of FPGA board, which can take input from analog and/or digital video camera, the ARM processor unit, and camera mounted stepper motor. Real time Image recognition algorithms are used to detect the region of interest (ROI) boundaries, instructor's face, and instructor's movement direction. The stepper motor rotates the mounted camera as directed by the FPGA controller to follow the lecturer and board. Further, the proposed system is designed in a compatible manner that can take input from a variety of video formats. Successful video lecture recording at Hanyang University lecture hall validated the performance of the system.

Keywords— Image recognition, FPGA, Lecture recording, stepper motor, face recognition.



Arbab Waheed Ahmad was born in Peshawar, Pakistan on 25th December 1986. He was a student member of IEEE during 2012-2013. He received B.Sc. degree in Electrical Engineering from University of Engineering and Technology (UET) Peshawar, Pakistan and M.Sc. degree in Electronics, Electrical, Control and Instrumentation Engineering from Hanyang University, Seoul South Korea in 2008 and 2012 respectively.

He served University of Engineering and Technology (UET) Peshawar, Pakistan as Lecturer from April 2009 to March 2010. In present, He is pursuing PhD in Electronics and Communication Engineering from Hanyang University, Seoul South Korea. He published several research articles. Some of them are listed here. "Maximizing Throughput with Wireless Spectrum Sensing Network Assisted Cognitive Radios" published in International Journal of Distributed Sensor Networks in October 2014. Another articles include "Implementation of ZigBee GSM based home security monitoring and remote control system" published in 54th IEEE international Midwest Symposium on

Circuits and Systems (MWSCAS) 2011 and "A USN based Automatic Waste Collection System" published in 14th International conference on Advanced Communication Technology (ICACT) 2012. His research focuses on heterogeneous cognitive small cells in 5G cellular networks.

Mr. Arbab is student member of several research societies. He is a student member of ETRI Korea. He is involved in several projects governed by Gyeonggi-do Regional Research Center (GRRC) since 2011. He is a professional member of Pakistan Engineering Council (PEC) Pakistan. He received MS fellowship from Higher Education Commission HEC Islamabad, Pakistan. His biography is published in Marquis Who's Who in the world in 2015 edition.



Heekwon Yang was born in Hongcheon, Gangwon-do South Korea on 7th May 1977. He received B.S. degree in Electrical Engineering from Koreatech University and M.Sc. degree in Electronics, Electrical, Control and Instrumentation Engineering from Hanyang University, Seoul South Korea in 2002 and 2012 respectively.

He was Research Associate in Vissem Company from December 2002 to February 2010. In present, He is pursuing PhD in Electronics and Communication Engineering from Hanyang University, Seoul South Korea. He published several research articles. Some of them are listed here. "Maximizing Throughput with Wireless Spectrum Sensing Network Assisted Cognitive Radios" published in International Journal of Distributed Sensor Networks in October 2014. Another articles include "Indoor positioning: A review of indoor ultrasonic positioning systems" published in 15th IEEE international conference on Advanced Communication Technology (ICACT) 2013 and "ZigBee based energy efficient outdoor lighting control system" published in 14th International conference on Advanced

Communication Technology (ICACT) 2012. His research focuses on wireless mesh networks for LED small lights and smart energy. He is involved in several projects governed by Gyeonggi-do Regional Research Center (GRRC) since 2011 till date.



Gul Shahzad born in Karachi, Pakistan in 1982 and completed his bachelor degree B.Sc. in electronics from Sir Syed University of Engineering and technology, Karachi, Pakistan in 2005. He did M.Sc. degree in information and communications engineering from THM Mittelhessen, Germany in 2008.

During the masters, he got the chance to work with Fraunhofer Institute for Integrated Circuit, Erlangen Germany as a research fellow and completed his thesis in doing research on high speed data transmission over polymer optical fiber. Currently he is pursuing PhD from Hanyang University under government of Pakistan fellowship. His research focuses on the smart application of wireless sensor networks in lighting and IoT.

He is involved in several projects governed by Gyeonggi-do Regional Research Center (GRRRC) since 2011. He is a professional member of Pakistan Engineering Council (PEC) Pakistan. He received PhD fellowship from Higher

Education Commission HEC Islamabad, Pakistan.



Professor Chankil Lee received a B.A. (1981) from Hanyang University, an M.S. (1983) in Electronics from Seoul National University, and a Ph.D. (1992) in Electrical Engineering from Georgia Institute of Technology.

As a senior researcher at ETRI, he accomplished the design and development of TDX-1 ESS and CDMA cellular communication system. Based on these research experiences, he published various papers related to mobile channel characterization, performance analysis of CDMA systems, real-time implementation of 3GPP/3GPP2 modem using DSP/FPGA, and more.

His current interest includes wire-line communication methods such as PLC, TCP/IP, and various serial transmission technologies. Together with wireless technology such as WBAN/WPAN/WLAN, he has been focusing on the applications of ubiquitous sensor network. He has been conducting many projects relating with

IT+energy, IT+environment, and IT+agriculture with industries. He has been involved in several research projects on wireless sensor networks and real-time locating systems. He is currently working in wireless sensor networks for home/building automation, energy savings, and vehicular communications.