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Smart Sensor Network Based Fire Rescue System Design using LabVIEW

Nagarjuna Telagam, Sunita Panda, Nehru Kandasamy, Menakadevi Nanjundan

***Abstract*: This paper enhances fire rescue system for reducing the number of victims in case of fire accidents. This system has been developed and implemented using the smart sensors and LabVIEW technology. It will automatically identify the fire accident and inform it to the rescue team (loco pilot for trains, security in buildings) through voice signal transmission. Servo motors are connected to water sprinklers to control fire. As an initial step, fire will be suppressed and intimation about the accident will be sent through short message service to the local fire stations, ambulance. This short message service consists of the status of fire accident accurately by transmitting the physical parameters. This also display the particular area code based upon that global system for mobile network. The complete details about the location (buildings, trains) could be intimated. With simple camera the number of members entered into the room can be known. So that directly saves the people instead of searching every room. As a whole this system ensures that it will reduce the human death ratio due to accidents.**

***Index Terms*: Data acquisition, LabVIEW, LM 35 Sensor, GSM.**

I. INTRODUCTION

Fire accidents will occur most frequently, causes the most diverse and can spread more or less rapidly depending on their causes [1].Real applications, such as habitat monitoring, environmental and structural monitoring, start to work in practical. The proposal FireNet, a wireless sensor network architecture for this specific type of application [2]. The alarm system is designed which has exit sign units having couplings to a smoke sensor and heat sensor for input information, the speech synthesizer and a strobe light to provide output [3]. A set of apparatus for determining thermal diffusivity based on the theory of transient heat-transfer is introduced, in which a software system for data collection and data processing is developed [4]. In this paper, a without wiring, good man-machine interface and system data and information display intuitive RFTR1 wireless fire monitoring and alarm system is designed. In this system, microcontroller STC12C5A60S2 act as center controller, designed to monitor interface of PC using LabVIEW development environment, PC communicate with the microcontroller via the serial port, in order to achieve multi-channel data acquisition and monitoring [5]. design of distributed control based on the idea of a single host hardware
detection of the corresponding multi-terminal-to-many wireless communication systems, host based system software to bulk single receiving means to achieve one to many of the same order code frequency wireless communications [6]. The prevalence of fire incidents in buildings resulting from electrical faults due to deficiencies in planning and installations [7]. This document presents an innovative system for the traditional air respirator used for fire rescue. This system took advantage of the Micro-Electro-Mechanical Systems inertial acceleration sensor to supervise the real time posture of the personnel, conducted the pressure measurement by replacing the mechanical watch with electronic pressure transmitter, and transferred the residual aeration to the helmet and handheld instrument of the team members with 433 MHz wireless sensor network[8]. This project proposes design and implementation of a remote diesel level monitoring system with an automated fire extinguishing system using wireless sensor network. The diesel level is to be sensed and transmitted wireless using ZigBee to a remote base station for processing and analysis. The system can be made secure by providing an automated fire extinguishing system, as the chances for fire accidents are high in diesel generators, as diesel is highly inflammable. The system can alert its officials by sending SMS using a GSM system [9]. This article proposes FDA system which is more traditional fire alarm and also has detection system [10]. A labVIEW based system is designed for security purpose in home, it can monitor different parameters such as temperature, humidity, lighting, fire and burglar alarm [11]. An emergency rescue system for use in rescuing persons trapped in the upper floors of a multistory building during emergency conditions such as during a fire or the like. The rescue system comprises a rescue gondola suspended alongside the exterior face of the building by a suspension cable [12]. This article explains the working of spark fun sensor based cruise control agricultural system which is used for automated agricultural system[13]. The simulation of modulation schemes such as amplitude modulation and frequency modulation are designed using VI models are used as reference for designing fire rescue system [14]. Smart sensor networks are designed which deals with air pollution monitoring[15] and industrial parameters monitoring using virtual instrumentation server [16] are designed using labview softwares with VISA driver and Virtual server are taken as references for our project. Universal software defined radio based labview programming models are also taken as references [17-20]. The smart sensor network based ATM system which deals with biomedical sesnsor for more security in the system [21].

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***** Correspondence Author

Nagarjuna Telagam*, Assistant Professor, ECE Department, GITAM University, Bangalore, India

Dr.Sunita panda, Assistant Professor, ECE Department, GITAM University, Bangalore, India

Dr.K.Nehru, Professor, ECE Department, Institute of Aeronautical Engineering, Hyderabad, India

Menakadevi Nanjundan, Assistant Professor, ECE Department, Hindustan College of Engineering and Technology, Coimbatore, India.

The paper explains in the different sections, section I explains the literature survey and list of references used to design our project, section II deals with system model for fire rescue system followed by labview programming explanation for each and every module, how it works and how it operates and finally section III explains the results and discussions which shows entire programming model and Section IV concludes the design.

II. IMPLEMENTATION

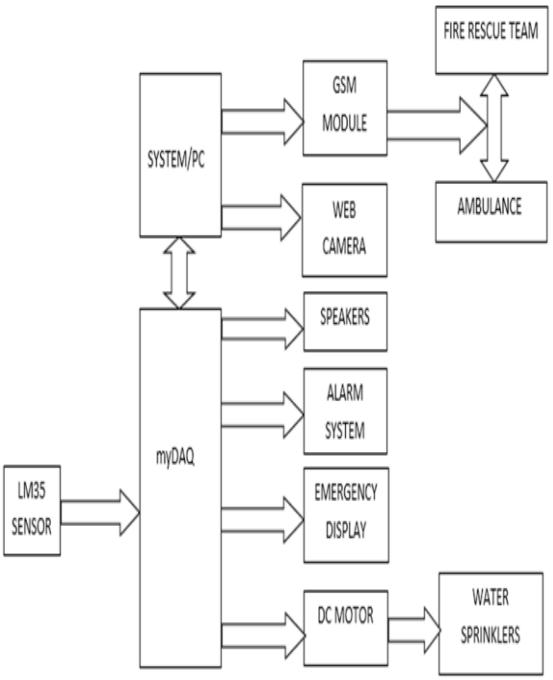

Fig 1. Block diagram of proposed system

Savvy home is a house that utilizations data innovation to screen nature, control the electric machine and speaks with the external world. Shrewd home is a mind boggling innovation, in the meantime it is creating. A keen home robotization framework has been created to consequently accomplish a few exercises performed much of the time in every day life to acquire increasingly agreeable and simpler life condition. An example house condition screen and control framework that is one part of the Smart home is tended to in this paper. The framework depends on the LabVIEW programming and can go about as a security gatekeeper of the home. The framework can screen the temperature, dampness, lighting, fire and robber alert, gas thickness of the house and have infrared sensor to ensures the family security. The framework likewise has web association with screen and control the house gear's from anyplace on the planet. This paper introduces the equipment usage of a multiplatform control framework for house mechanization utilizing LabVIEW. Such a framework has a place with a space normally named brilliant house frameworks. The methodology consolidates equipment and programming advances. Test consequences of the framework have demonstrated that it very well may be effectively utilized for the shrewd home robotization applications. In the quick moving world, no one is prepared to look what's going on around them. Notwithstanding when a mishap happens no one thinks about it. So we have executed an answer for this issue by building up an upgraded flame salvage framework for lessening the quantity of unfortunate casualties if there should arise an occurrence of train fire mishaps. This framework has been created and actualized utilizing the keen sensors and LabVIEW innovation. It will naturally distinguish the flame mishap and illuminate it to the salvage group (security in structures) through voice signal transmission. Servo engines are associated with water sprinklers to control fire. As an underlying advance, fire will be stifled and suggestion about the mishap will be sent through Short Message Service (SMS) to the nearby flame stations, emergency vehicle.

For implementation of fire rescue system we have used hardware components like LM 35 temperature sensor, DC Motor, GSM Module, speakers, webcam, LED Lights, Buzzer. To interface all the hardware components with system and myDAQ are explained below.

2.1 LM35 Temperature Sensor:

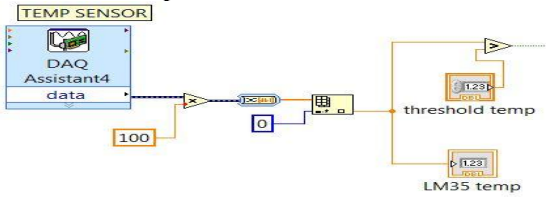

Fig 2. LM35 Temperature Sensor Code

LM35 sensor is a precision integrated-circuit temperature device with an output voltage linearly-proportional to the Centigrade temperature. LM35 sensor consists of three pins v_{cc} ,v_{out} and gnd.the v_{vc} pin is connected to 5v of mydaq, gnd is connected to analog ground and v_{out} is connected to analog input using a breadboard. Daq assistant in the labview software acts as interface to the hardware components and software .When the LM35 sensor detects the temperature ,the output will be in the form of voltage i.e for 1 centigrade temperature it generates 0.1v of voltage .the output is converted into digital form by multiply the value with 100,then the values are executed as dynamic values which are then converted into form arrays values i.e every value is stored in the form of array by using dynamic to array converter. Now when the value detected is above the threshold value automatically six applications start working automatically.

2.2 Alarm System:

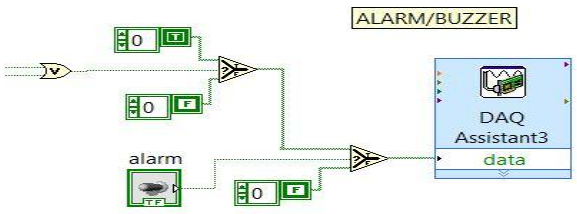

Fig 3. Alarm System Code

Alarm system is used for alarming by giving an alarm sound whenever a fire accident occurs in buildings. We have developed a code by taking two/three rooms and whenever a fire accident occur, may be in one or two rooms the alarm sound should be generated .So we have taken OR gate condition in which any of the input is 1,then output will be 1.A case selector is used which allows the output which occurred it may be true or false.

2.4 Camera:

To acquire images there is a tool called vision and motion in LabVIEW which consists of certain functions like open camera, configure, grab, close camera which are required to start and configure camera. In this open camera and configure functions are used to select the camera port like cam0 or cam1 and configures it to the system. The grab function has a image display or image terminal, so the grab function is placed within the while loop and connected to the case structure.

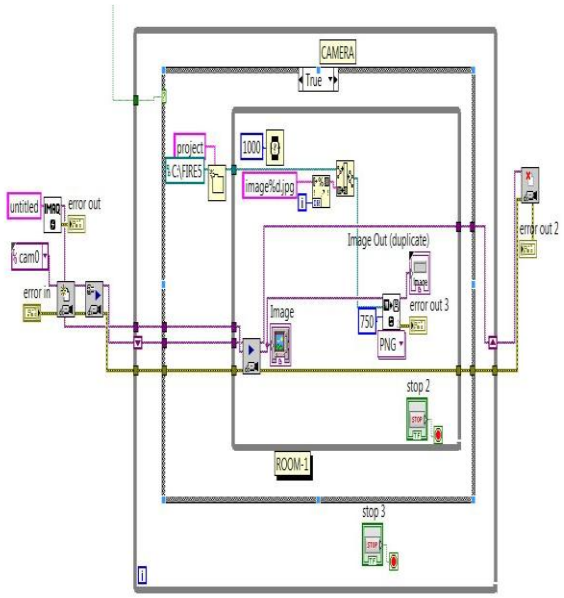

Fig 4. Camera Code

To capture the images the vision palette consists of "imaq write" which is used to copy the images at particular iteration and stores it in the file path. from the file path it is connected to the build path which helps storing the images into multiple paths and the names for the different images are given by using the format into string. The build path o/p i.e file path is connected to the create folder which has file path name like "c:/file name". whenever the case structure gets true condition ,the camera runs and stores the images into the particular folder.

2.5 Water Sprinkler:

Water sprinkler is used to reduce the fire in the initial stage whenever a fire accident occurs. We have taken a dc motor which is common for all the rooms .So, we used a OR gate operation in which any of the input is 1,then output will be 1.

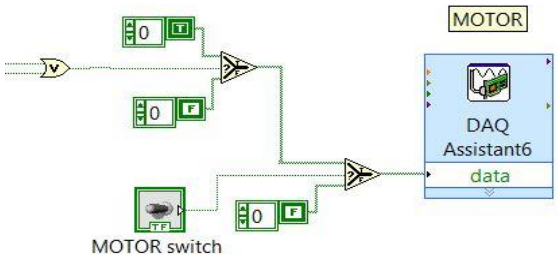

Fig 5. Motor Code

A case selector is used which allows the output which occurred it may be true or false i.e "true" or "1" is passed to the case selector, then it directly sends true terminal to the output which is true and another case selector taken and here a switch is connected to case terminal of case selector which is on condition and when ever a true case is sent to the terminal and the motor runs. Switch is used here to off the motor after sometime.

2.6 Emergency Floor Display:

Emergency floor display is placed near the security system room so that whenever a fire accident occurs, the led's of particular room will be displayed so that rescuing the fire victims will be fast. In this we took a case which is false and gives this input to case selector. It has four terminals (case, true, false, and output). If case is T then the terminal case sends to output parallel for case F. the output given to LED in digital case if T it glows or F it will be off.

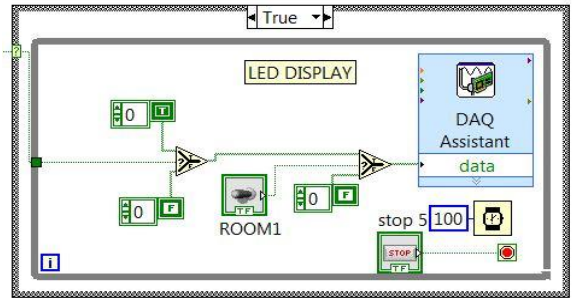

Fig 6. LED Display Code

2.7 GSM Module:

GSM module basically used to send a message to specific mobile number. We use SIM900A module in our project to send alert message to the ambulance and fires stations.

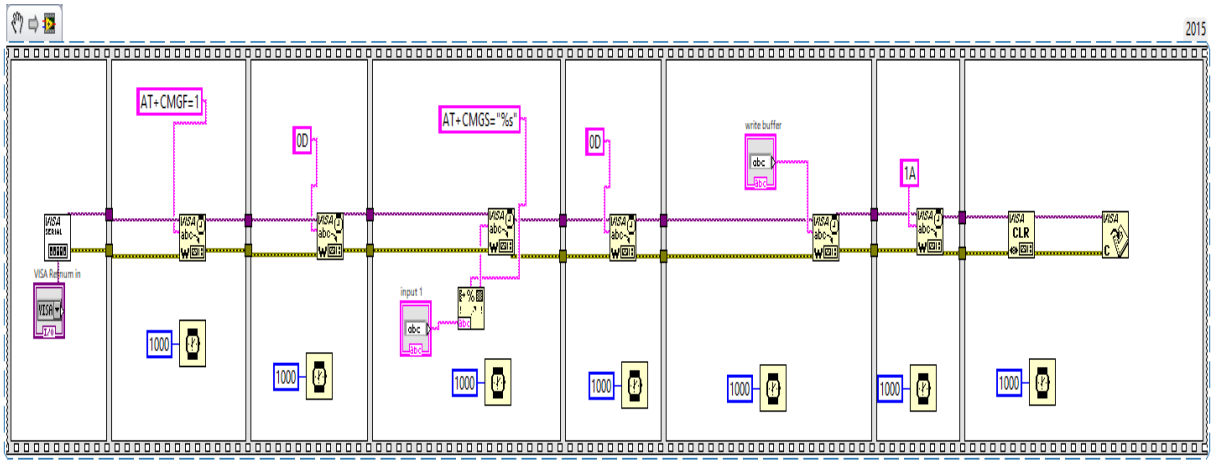

Fig 7. GSM Module Code

GSM module basically used to send a message to specific mobile number. We use SIM900A module in our project to send alert message to the ambulance and fires stations.

2.8 Text To Speech Alerts:

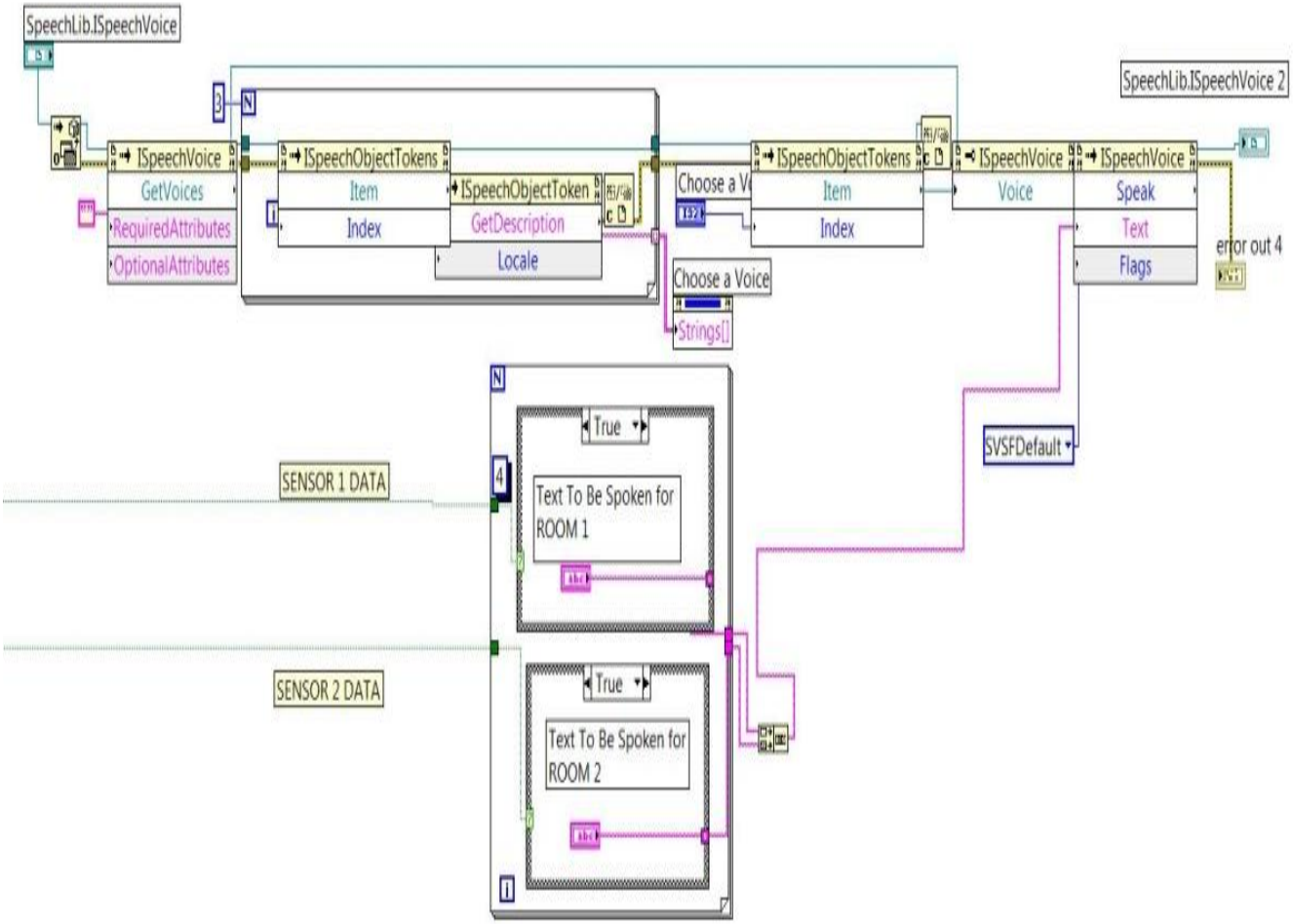

Fig 8. Text to speech code

Text to speech voice alerts are used to alert the people through the speakers. We place the speakers in every room so, whenever a fire accidents occurs in the building a voice alert is generated from the speaker indicating which room has attacked by fire. This text to speech code is written in labview using the invoke nodes which are present in ActiveX tool. There are certain functions which are used to generate text to speech alerts that are automation open, invoke node, close reference.

III RESULTS AND DISCUSSIONS

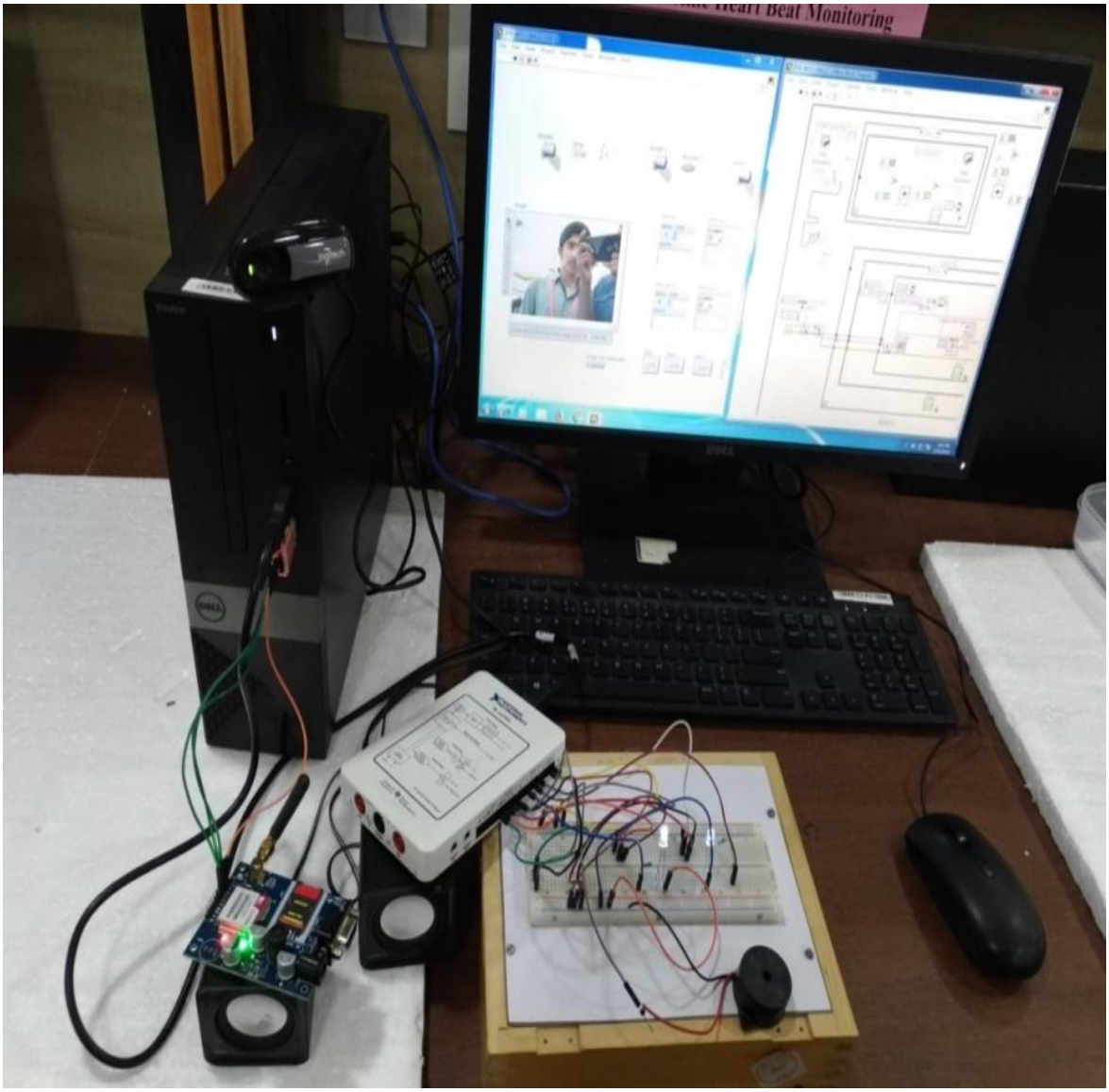

Fig 10. Experiment set up

The total code is written inside the while loop, because it executes at least one time. In this number of iterations are controlled by us. We have developed this code for several rooms and the code is similar for other rooms. The LM35 sensor and other hardware components are connected to DAQ pins and DAQ is connected to the system and the interface of hardware components with LabVIEW software is done by a DAQ assistant tool in the LabVIEW software. The total code is controlled by LM35 sensor values. Its gives 10mv output for 1^0C, if 20^0C it will give 0.2v. So that we convert it into volts by multiplying by 100, so we get 20v. This is dynamic data which changes rapidly for every variation in temperature. So we are converting it into an array. In this array the data is updated we choose 0^{th} index array values and compare it with threshold voltage which was given by us. If it is greater than the threshold, Six features are performed simultaneously. These are given as, Alarm, Emergency Floor Display, Water Sprinkler, Camera, GSM Module, Text To Speech.

3.1 LabVIEW code:

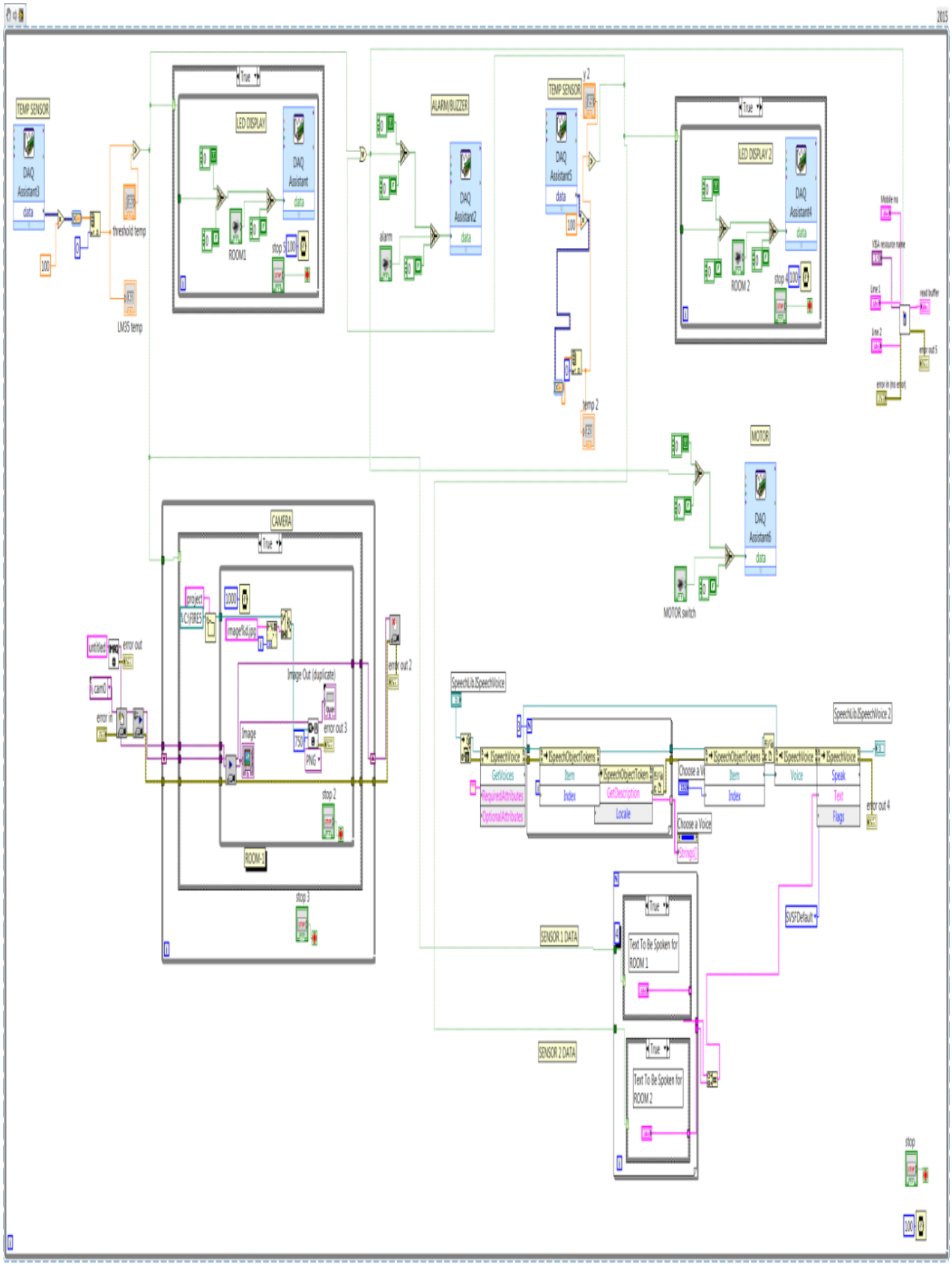

Fig 11. LabVIEW Program VI Snippet

3.2 Front Panel:

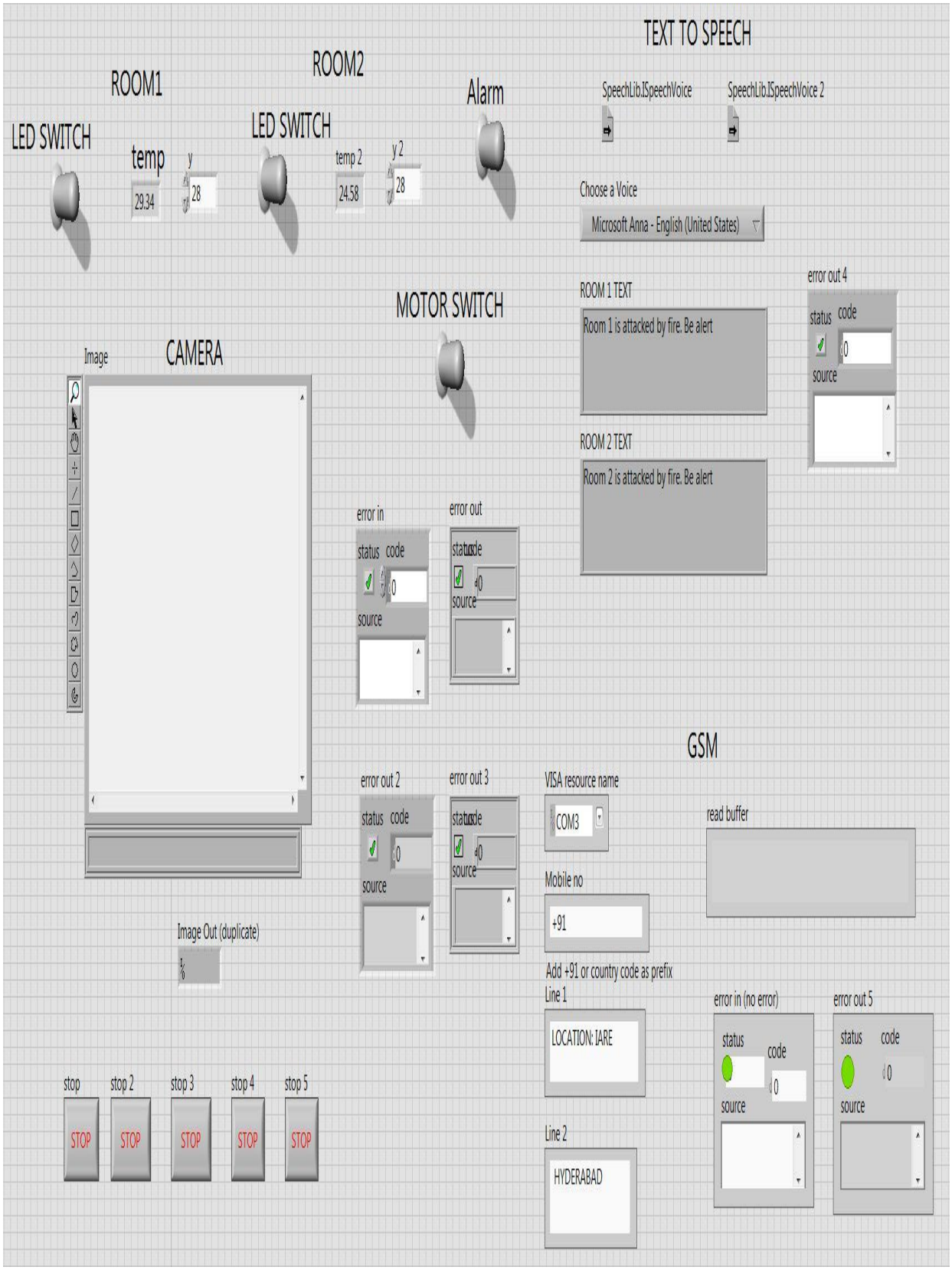

Fig 12.Front panel

In the above figure all controls and indicators are given. The switches of LED, buzzer and motor are used to control those components.

3.3 Proto Type:

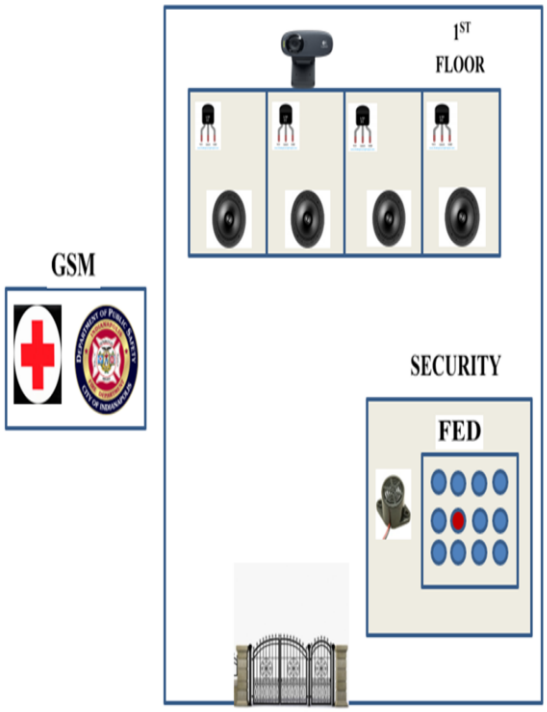

Fig 13. Prototype

3.4 Camera Images:

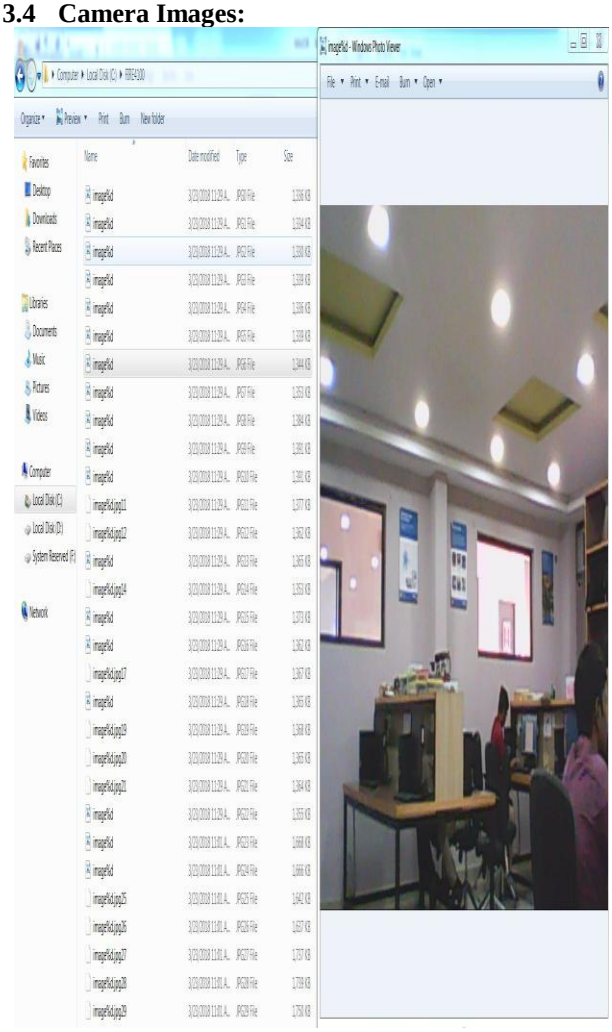

Fig 14. Camera Images

These captured images are stored in a separate file path which is given by the user. It is possible to set a password to VI. So, these are may safe.

IV. CONCLUSION

This working system is based on LabVIEW. This system will be very much useful for reducing the accident by detecting fire at initial stage itself, alerting the peoples, passing the message to the near ambulance and fire rescue station, immediate actions to avoid spreading of fire, alerting every room by giving voice alerts. So, they can easily understand which room has been in caught, by using camera we can capture the images and we can see the live action of rooms in case of to know how many victims are inside of the room with danger. Hence the system is much secured. Fire is a good servant and it's a bad slave, so we should handle carefully and safely. Fire on one room is more catastrophic, than a stationary one. Since fanning by wind helps spread the fire to other rooms. Thus by implementing the above concept we provide a complete solution for fire accident. It could be alert more faster.

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AUTHORS PROFILE

Nagarjuna Telagam is currently working in ECE Department, GITAM University, Bangalore, India. His topics of interest are OFDM, GFDM and wireless sensor networks. He published 25 papers in Scopus indexed Journals and 4 SCIE journals. He got CLAD certification from National Instruments. He Can be reached at Nagarjuna473@gmail.com

Sunita Panda is with Electronics and Telecommunication Engineering department, GITAM University, Bangalore campus. Currently she is Assistant Professor, Her areas of interest are soft computing, channel equalization, Digital Signal processing. She Can be reached at Sunita.na no@gmail.com

Nehru Kandasamy is with Electronics and Communication Engineering, Institute of Aeronatuical Engineering, Hyderabad, India. He Can be reached at **nnehruk@gmail.com**

Menakadevi Nanjundan is with the Electronics and Communication Engineering Department, Hindustan College of Engineering and Technology, Coimbatore, India. She can be reached at menakadevin@gmail.com