ZIGBEE COMMUNICATION SYSTEM BASED WIRELESS ELECTRONIC NOTICE BOARD

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ABSTRACT

In coming day's is to face new challenges. Hence every field prefers automated control systems. Especially in the field of electronics automated systems are doing better performance. Notice Board is primary thing in any institution / organization or public utility places like bus stations, railway stations and parks. But sticking various notices day-to-day is a difficult process. A separate person is required to take care of this notices display. This project deals about an advanced hi-tech wireless notice board. The project is built around the AT89S52 micro controller from Atmel. This micro controller provides all the functionality of the display and wireless control. It also takes care of creating different display effects for given text. Alphanumerical keypad is interfaced to the transmitter to type the data and transmit. The message can be transmitted to multi point receivers. After entering the text, the user can disconnect the keyboard. At any time the user can add or remove or alter the text according to his requirement. This project uses regulated 5V, 1A power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformer.

Keyword: - *Key word1, Key word2, Key word3, and Key word4 etc….*

1. INTRODUCTION

Wireless technology has been making tremendous progress over the past few years. The ever increasing use of wireless networks serves as an indicator of the progress in the area of wireless networks. The demand for wireless technology is increasing not only in industrial applications but also for domestic purposes.[1] Completes the access technology portfolio: customers commonly use more than one access technology to ser- vice various parts of their network and during the migration phase of their networks, when upgrading occurs on a scheduled basis. Wireless enables a fully comprehensive access technology portfolio to work with existing dial, cable, and DSL technologies.[1] Goes where cable and fiber cannot: the inherent nature of wireless is that it doesn't require wires or lines to accommodate the data/voice/video pipeline. As such, the system will carry information across geographical areas that are prohibitive in terms of distance, cost, access, or time. It also sidesteps the numerous issues of ILEC colocation. Involves reduced time to revenue: companies can generate revenue in less time through the deployment of wireless solutions than with comparable access technologies be- cause a wireless system can be assembled and brought online in as little as two to three hours.[1] Provides broadband access extension: wireless commonly both competes with and complements existing broadband access. Wireless technologies play a key role in extending the reach of cable, fiber, and DSL markets, and it does so quickly and reliably. It also commonly provides a competitive alternative to broadband wireline or provides access in geographies that don't qualify for loop access.[1]

The detailed comparative study of different short-range wireless protocols viz. Blue- tooth (over IEEE 802.15.1), UWB (over IEEE 802.15.3), Zig- Bee (over IEEE 802.15.4) and Wi-Fi (over IEEE 802.11a/b/g). Main

features and behaviors in terms of various metrics, including capacity, network topology, security, quality of service support, and power consumption are studied for the comparison. The proposed model in this report consists of two modules i.e. one or more Transmitter and one Receiver module. The transmitter module consists of interfacing computer via serial interface to the Zigbee module. The receiver module placed at the remote end consists of Zigbee module interfaced with a micro- controller for displaying messages on LCD. Password based Authentication is employed on the Transmitter side in order to provide access control to only authorized users. Primarily16x2 LCD is been used for displaying messages which we can further extend to larger LCD.[1]

ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices. WPAN Low Rate or ZigBee provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. ZigBee makes possible completely networked homes where all devices are able to communicate and be controlled by a single unit. The ZigBee Alliance, the standards body which defines ZigBee, also publishes application profiles that allow multiple OEM vendors to create interoperable products. [5] The current list of application profiles either published or in the works are:

- Home Automation
- ZigBee Smart Energy
- Telecommunication Applications
- Personal Home

Relationship between IEEE 802.15.4 and ZigBee is similar to that between IEEE 802.11 and the Wi-Fi Alliance. For non-commercial purposes, the ZigBee specification is available free to the general public. An entry level membership in the ZigBee Alliance, called Adopter, costs US$ 3500 annually and provides access to the as-yet unpublished specifications and permission to create products for market using the specifications. ZigBee is one of the global standards of communication protocol formulated by the relevant task force under the IEEE 802.15 working group.The fourth in the series, WPAN Low Rate/ZigBee is the newest and provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. Other standards like Bluetooth and IrDA address high data rate applications such as voice, video and LAN communications.[9]

ZigBee devices are actively limited to a throughrate of 250Kbps, compared to Bluetooth's much larger pipeline of 1Mbps, operating on the 2.4 GHz ISM band, which is available throughout most of the world.In the consumer market ZigBee is being explored for everything from linking low-power household devices such as smoke alarms to a central housing control unit, to centralized light controls. ZigBee notice board is an advanced hi-tech wireless notice board. ZigBee is based on PAN technology which has the ability to form a mesh network between nodes. This allows the short range of an individual node to be expanded and multiplied, covering a much larger area. The ZigBee used in this project is of Digi Company and operates at a frequency of 2.4GHz.[6] The project is built around the ATMEGA16 micro controller from Atmel. This micro controller provides all the functionality of the display, wireless control and creating different display effects for given text. The ZigBee module is interfaced with the PC. The message can be transmitted to multi-point receivers. It uses regulated 5V, 1A power supply. 7805 three terminal voltage regulator is used for voltage regulation.[4]

2. Literature Survey

Basically this topic can be differentiate by 3 main components/ technology such as ZigBee, Graphic LCD, wireless technology and PIC18F14K50 which play an important roles to develop a better, compatible, user friendly and cost efficient smart notice board than other existing system .In general, this project consists of two major parts that need to be developed; Hardware and software. For the hardware part it consists of system board which includes Zigbee, relays and some basic electronic components. In this Zigbeeplays an important role. [1]. ZigBee is an IEEE 802.15.4 standard for data communications with business and consumer devices. It is designed around low-power consumption allowing batteries to essentially last forever. The ZigBee standard provides network, security, and application support services operating on top of the IEEE 802.15.4 Medium Access Control (MAC) and Physical Layer (PHY) wireless standard. It employs a suite of technologies to enable scalable, self-organizing, self-healing networks that can manage various data traffic patterns. ZigBee is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. ZigBee has been developed to meet the growing demand for capable wireless networking between numerous low power devices. In industry ZigBee is being used for next generation automated manufacturing, with small transmitters in every device on the floor, allowing for communication between devices to a central computer. This new level of communication permits finely-tuned remote monitoring and manipulation.[3]

The ZigBee Alliance [ZIG05] is an association of companies working together to develop standards (and products) for reliable, cost-effective, low-power wireless networking and it is foreseen that ZigBee technology will be embedded in a wide range of products and applications across consumer, commercial, industrial and government markets worldwide.[5] ZigBee builds upon the IEEE 802.15.4 standard which defines the physical and MAC layers for low cost, low rate personal area networks. It defines the network layer specifications, handling star and peer-to-peer network topologies, and provides a framework for application programming in the application layer.[2]

Notice Board are the primary thing variety of any insititution , organization or public utility places like bus station, railway station and parks. Which we comes across on daily basis. In the current scenario the notice/advertisement board are being managed manually. A separate person is required to take care of of notice board . there is long process involved in order to put up notices papers,print ink, man power and also bring about loss of time. The proposed a system enables people to wirelessly transmitted notice on notice board using Zigbee.

Electronic Notice Board is one of the application where Zigbee can be used effectively. It can also be used in Malls and Highways for Advertisement purpose. A moving display with variable speed can also be used in place of static display. Wireless operations permit services, such as long-range communications, that are impossible or impractical to implement with the use of wires. It provides fast transfer of information and are cheaper to install and maintain. This paper provides an efficient way of displaying messages on Notice Board using Wireless Technology. It also provides user authentication in order to avoid any misuse of proposed system.[1]

3. System Design

ZigBee is a home-area network designed specifically to replace the proliferation of individual remote controls. ZigBee was created to satisfy the market's need for a cost-effective, standards-based wireless network that supports low data rates, low power consumption, security, and reliability. To address this need, the ZigBee Alliance, an industry working group (www.zigbee.org), is developing standardized application software on top of the IEEE 802.15.4 wireless standard. The alliance is working closely with the IEEE to ensure an integrated, complete, and interoperable network for the market. For example, the working group will provide interoperability certification testing of 802.15.4 systems that include the ZigBee software layer. The ZigBee Alliance will also serve as the official test and certification group for ZigBee devices. ZigBee is the only standards-based technology that addresses the needs of most remote monitoring and control and sensory network applications.[5]

3.1 Architecture

It may be helpful to think of IEEE 802.15.4 as the physical radio and ZigBee as the logical network and application software. Following the standard Open Systems Interconnection (OSI) reference model, ZigBee's protocol stack is structured in layers. The first two layers, physical (PHY) and media access (MAC), are defined by the IEEE 802.15.4 standard. The layers above them are defined by the ZigBee Alliance. The IEEE working group passed the first draft of PHY and MAC .[6]

ZigBee-compliant products operate in unlicensed bands worldwide, including 2.4GHz (global), 902 to 928MHz (Americas), and 868MHz (Europe). Raw data throughput rates of 250Kbps can be achieved at 2.4GHz (16 channels), 40Kbps at 915MHz (10 channels), and 20Kbps at 868MHz (1 channel). The transmission distance is expected to range from 10 to 75m, depending on power output and environmental characteristics. Like Wi-Fi, Zigbee uses direct-sequence spread spectrum in the 2.4GHz band, with offset-quadrature phase-shift keying modulation. Channel width is 2MHz with 5MHz channel spacing. The 868 and 900MHz bands also use direct-sequence spread spectrum but with binary-phase-shift keying modulation.[6]

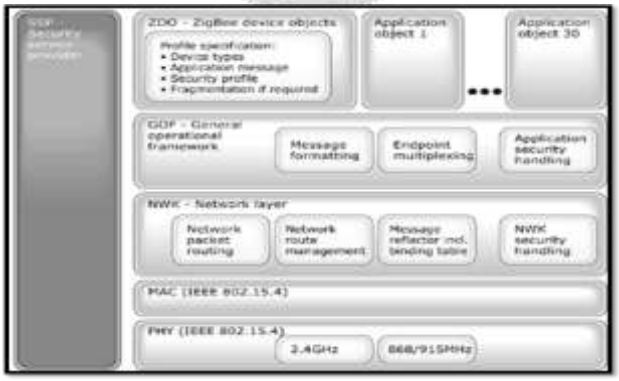

Fig -1 ZigBee stack architecture

3.2 Frame Structure

The data frame provides a payload of up to 104 bytes. The frame is numbered to ensure that all packets are tracked. A frame-check sequence ensures that packets are received without error. This frame structure improves reliability in difficult conditions. Another important structure for 802.15.4 is the acknowledgment (ACK) frame. It provides feedback from the receiver to the sender confirming that the packet was received without error. The device takes advantage of specified "quiet time" between frames to send a short packet immediately after the datapacket transmission.[3]

A MAC command frame provides the mechanism for remote control and configuration of client nodes. A centralized network manager uses MAC to configure individual clients' command frames no matter how large the network.[3] Finally, the beacon frame wakes up client devices, which listen for their address and go back to sleep if they don't receive it. Beacons are important for mesh and cluster tree networks to keep all the nodes synchronized without requiring those nodes to consume precious battery energy by listening for long periods of time.[3]

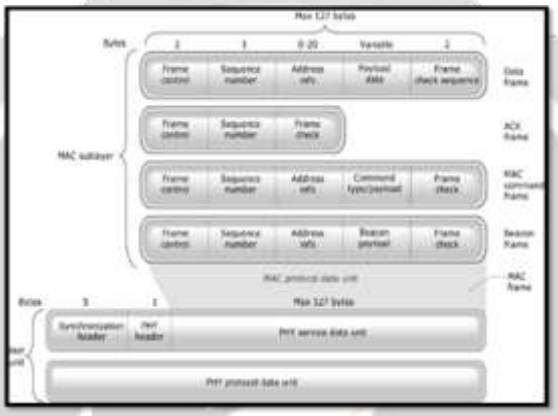

Fig 2: The four basic frame types defined in 802.15.4: Data, ACK, MAC command, and beacon

3.3 Traffic Types

ZigBee/IEEE 802.15.4 addresses three typical traffic types. IEEE 802.15.4 MAC can accommodate all the types.

1. Data is periodic: The application dictates the rate, and the sensor activates, checks for data an deactivates.

2. Data is intermittent.: The application, or other stimulus, determines the rate, as in the case of say smoke detectors. The device needs to connect to the network only when communication is necessitated.This type enables optimum saving on energy.

3. Data is repetitive, and the rate is fixed a priori. Depending on allotted time slots, called GTS (guaranteed time slot), devices operate for fixed durations.[8]

ZigBee employs either of two modes, beacon or non-beacon to enable the to-and-fro data traffic. Beacon mode is used when the coordinator runs on batteries and thus offers maximum power savings, whereas the non-beacon mode finds favour when the coordinator is mains-powered. In the beacon mode, a device watches out for the coordinator's beacon that gets transmitted at periodically, locks on and looks for messages addressed to it. If message transmission is complete, the coordinator dictates a schedule for the next beacon so that the device ‘goes to sleep'; in fact, the coordinator itself switches to sleep mode. While using the beacon mode, all the devices in a mesh network know when to communicate with each other. In this mode, necessarily, the timing circuits have to be quite accurate, or wake up sooner to be sure not to miss the beacon. This in turn means an increase in power consumption by the coordinator's receiver, entailing an optimal increase in costs.[9] The non-beacon mode will be included in a system where devices are ‘asleep' nearly always, as in smoke detectors and burglar alarms. The devices wake up and confirm their continued presence in the network at random intervals. On detection of activity, the sensors ‘spring to attention', as it were, and transmit to the ever waiting coordinator's receiver (since it is mainspowered). However, there is the remotest of chances that a sensor finds the channel busy, in which case the receiver unfortunately would ‘miss a call'.[9]

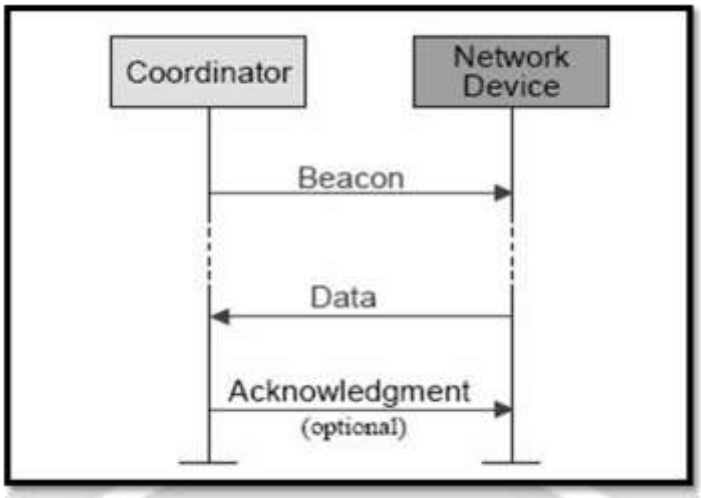

Fig 3: Beacon Network Communication

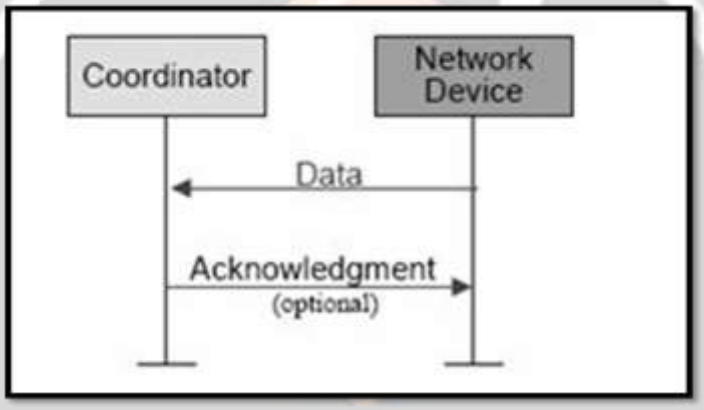

Fig 4: Non-Beacon Network Communication

3.4 Channel Access ,Addressing

Two channel-access mechanisms are implemented in 802.15.4. For a non"beacon network, a standard ALOHA CSMA-CA (carrier-sense medium-access with collision avoidance) communicates with positive acknowledgement for successfully received packets. In a beacon-enabled network, a superframe structure is used to control channel access. The superframe is set up by the network coordinator to transmit beacons at predetermined intervals (multiples of 15.38ms, up to 252s) and provides 16 equal-width time slots between beacons for contention-free channel access in each time slot. The structure guarantees dedicated bandwidth and low latency. Channel access in each time slot is contention-based. However, the network coordinator can dedicate up to seven guaranteed time slots per beacon interval for quality of service.[8] Device addresses employ 64-bit IEEE and optional 16-bit short addressing. The address field within the MAC can contain both source and destination address information (needed for peer-to-peer operation). This dual address information is used in mesh networks to prevent a single point of failure within the network[8].

3.5 Transmitter

The PC is the data is in the form of an image. This image has to undergo few image processing techniques in order to get a final black and white image of 128 x 64 resolution. This is achieved with the help of MATLAB which is in the PC. The XBEE Explorer is provides the base for the ZigBee. The data from the PC is transmitted using COM PORT to the explorer and then to the ZigBee. ZigBee is used for wireless communication. The data is then transmitted as it is from the ZigBee to another ZigBee in the receiver section. The baud rate is 115200. A voltage regulator is designed to automatically maintain a constant voltage level. It is used to stabilize the DC voltages used by the processor and other elements. It is used in the Transmitter section to stabilize the voltage at the output of MAX232 before passing it to Zigbee Module.[3]

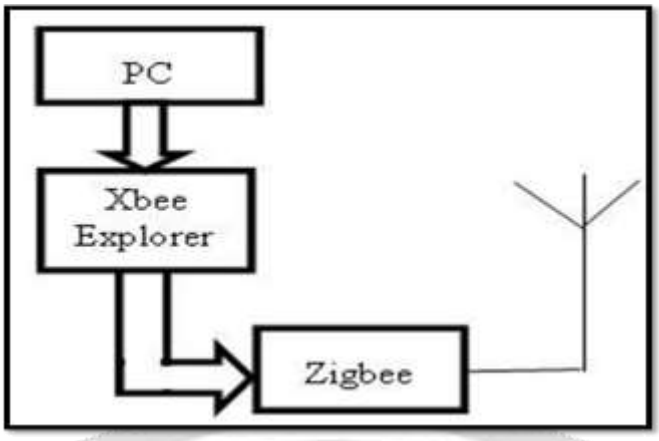

Fig 5: Transmitter Block Diagram

3.6 Receiver

The receiver ZigBee accepts the data from the transmitting ZigBee and is given to the microcontroller ATMEGA16. For proper communication it is essential that both the ZigBee must be adjusted to the same baud rate i.e. 115200. Power Supply is operated on the Micro-controller needs power supply to operate. Thus the power supply provides 5 volts dc supply .ATMEGA16 is a 16KB micro-controller.[4] The data from the receiving ZigBee is given to the micro controller. The micro-controller decides whether to print white or black pixel on the GLCD depending on the data received. The RESET pin is used to reset the controller. A 16MHz crystal oscillator is required by the controller to execute its operation. Contrast Control provides order to adjust the brightness of the GLCD, contrast control is used. This contrast is achieved using a variable potentiometer. 2.2.6 128 X 64 GLCD (Black And White) .GLCD screen of 128x64 resolution is used to display the image that is being transmitted through the ZigBee. An exact replica of the original image should be obtained on GLCD if there is no disturbance in the communication path.[3] Zigbee module on the receiver side is interfaced with UART(Universal Asynchronous Receiver/ Transmitter) of Micro-Controller PIC16F877A. Micro-Controller receives the message from Zigbee module on receiver side and displays it on the LCD screen. It also provides Synchronization between Transmitter and Receiver[4].

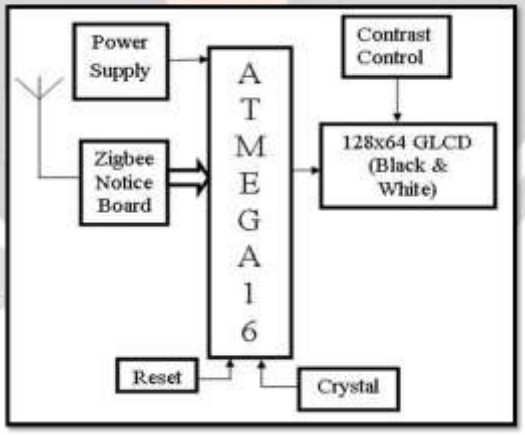

Fig 6: Receiver Block Diagram

3.7 Working of Zigbee Notice Board

In this circuit, the microcontroller ATMEGA16 of 16KB memory is used with help of 16MHz crystal connected across pin number 9 and 10 and a reset pull up at pin number 1 which pulls up to Vcc=+5V. An XBee shield is connected for reception of the data and its TX and RX pins are connected across pin number 2 and 3 of ATMEGA16 respectively. GLCD used is 128 x 64 pixels and connected across 11 and 14 pins. We are transmitting via USB explorer which converts USB port to RS-232 communication which again has RX and TX pins which are connected to XBee's TX and RX pins respectively. The MATLAB program on the PC sends the data to the USB, USB to RS-232 and then to XBee which is transmitting at PAN ID 31 at baud rate of 115200 to other XBee.[2]

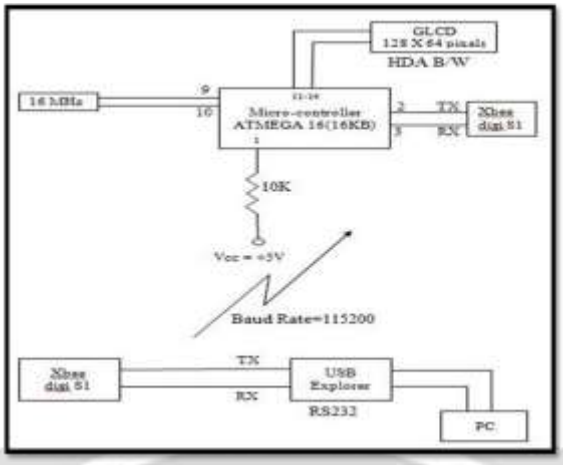

Fig 7: Circuit Diagram

The MATLAB program in the PC reads the image. If the image is colored then it will convert it into Black and White and if the image is already Black and White it is converted to 128 x 64. Thus, the colored image is converted to gray scale and then to Black and White. Now, the Black and White image means only '0' and '1' and for gray image it is between 0 to 255. All the values above and equal to 128 is considered to be '1' whereas the values below 128 is considered to be '0' and in this way you convert gray image to Black and White image.[7]

3.8 Image color conversion

Once the data is processed using few image processing techniques in MATLAB, it is then compiled before it starts to execute. The data is in the form of an image. During execution, each pixel of the image is compared with binary 1 or 0. If the binary value corresponding to the first pixel is 1, then binary 1 is given to USB COM port and then to the transmitting XBee. This XBee will transmit the data as it is to the receiving XBee. The XBee at the receiver transmit the data to the micro controller. The baud rate of the transmitting and receiving XBee is 115200. The micro controller is coded in such a way that if binary 1 is received then it prints a white pixel at the corresponding pixel else if binary 0 is received then it will print black pixel. At a time only one pixel value can be transmitted and received. This process goes on until the entire image (i.e. from first pixel to the last pixel) has been read.[7]

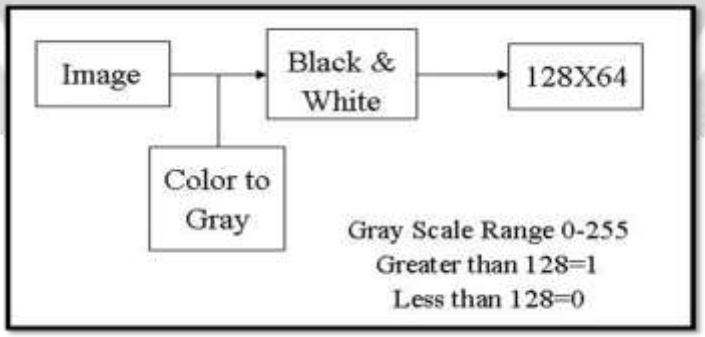

Fig 8: Image color conversion

3.9 Flow Chart for Matlab Program

The flow chart of MATLAB program can be described as: the execution starts by reading the image, then it checks whether the image is colored or not, if yes convert it to gray scale and then into Black and White or else directly into Black and White image. The Black and White image is finally obtained. Then it checks for size whether it is greater than 128 x 64 or less than 128 x 64 or equal. If it is equal to 128 x 64, the image is directly transmitted to USB COM port from where XBee module is connected. If it is greater than 128x64 then it will shrink or if it is less than 128x64 it will enlarge. Thus, finally we get an image of 128 x 64. Then the program checks the last image if it is yes then it will stop the execution else it will read the new image and continue the above process.[7]

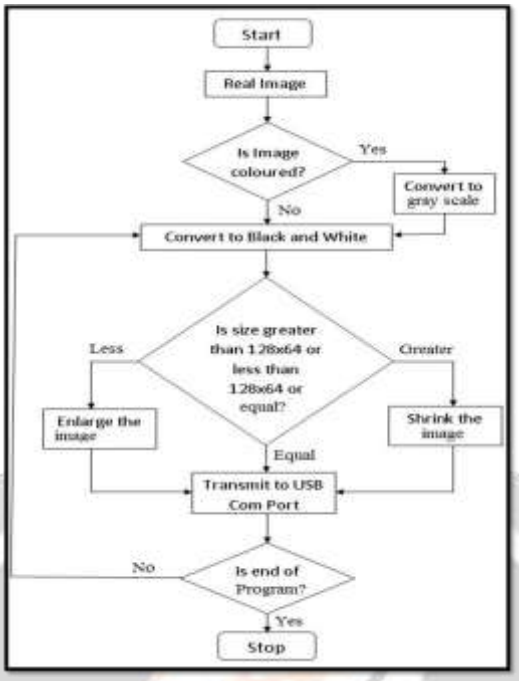

Fig 9 : Flowchart for MATLAB Program

4. CONCLUSIONS

Tranmission of data in the form of an image from the PC to the GLCD via the ZigBee is done. ZigBee have a long life time along with low power consumption as compared to Bluetooth and WIFI. Also, by connecting ZigBee in mesh network we can increase the range of communication. The hardware can be implemented on a large scale at various public places like highways, railway and bus station, airports etc. Wireless operations permit services, such as long-range communications, that are impossible or impractical to implement with the use of wires. It provides fast transfer of information and are cheaper to install and maintain. This paper provides an efficient way of displaying messages on Notice Board using Wireless Technology. It also provides user authentication in order to avoid any misuse of proposed system.

5. REFERENCES

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