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E-Board based on LoRa Communication

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Abstract: **An Information Board is a primary thing in any institution / organization or public utility places like bus stations, railway station and parks. The proper maintenance of the information displayed needs an additional man power, and in this scenario we propose an electronic board that can be used for information displaying. The E- board features on dynamic displaying of the information in the format required by the user on a 2 x 3 feet LED matrix. The user is provided with a facility for changing the color of the text displayed as per the users desire. The system features with controlling and configuring the system from distant location by different authenticated users. This feature is enabled by incorporating the latest wireless communication technology called the LoRa.**

I. INTRODUCTION

Anotice Board is a place/object where an authenticated authority can leave public messages to advertise things, announce events or provide information of general concern for any important issue. The traditional method of writing/ typing the notice on paper, and having a man/ woman deliver the notice to the respective groups, or having him/ her paste the notice on the notice board, is prone to errors. Also, during this eco-conscious age, the concept of printing paper and posting it on notice boards is not very green. Also, cluttered bulletin board that is full of information can become confusing. With the electronics industry moving at a fast pace, we are able to solve many such problems with digital replacements.

This paper elucidates a LoRa based E-Board in order to overcome the drawbacks of conventional notice board. It also involves the testing of the LoRa transceiver. The information to be displayed can be send by authentic users via an android app to the LED matrix board.

The main feature of this E-Board is that it uses LoRa technology as the communication module. Lora is a wireless technology which enables communication over long distances without any repeaters, with extremely low power requirement. LoRa can get long ranges, so it reduces dramatically the size of the backbone network (repeaters, gateways or concentrators). The proposed system gives advantages over conventional EBoard like the use of LCD display which is difficult to view from a distance. Such a system is comparatively expensive [1]. These system supports only one message at a time where GSM will not work properly if there is any network problem [2][3][4][5]. Since the messages to be displayed are sent as SMS it is costly.

II. OBJECTIVES

The key objective of the project is to design and develop an E- Board Based on LoRa Communication currently for the college campus (VAST). Messages can be send via android app. The E- Board can be operated remotely using an android app anywhere within the college premises. The app is used to pass various information like campus news, Principal and HOD announcements, circulars from administrative office, bus circulars, information of venues of various recruitment drives, contests, workshops etc in the campus.

LoRa based E-Board is used for displaying notices/messages at places that require realtime noticing. The font size and font color is customizable. It can display multiple information at a time. Only authenticated users can avail the system. It is possible to control and configure the board from distant locations.

III. SYSTEM DESCRIPTION

Several institutions like colleges, railway station and bus stations in several localities refuse to put up an E- board because it is easy buying a TV but as a last resort buy the same which is expensive and cannot be repaired if damaged. Thus we propose an E- board using LED matrix which uses several colors just enough to attract the people's attention which significantly reduces the cost that would've been spent in buying an LED screen.

The usual trend of using GSM and Wifi modules for communication between user and an electronic board has only resulted in either higher power usage or shorter ranges. Using the emerging LoRa wireless communication technology the issues for range is satisfied as it provides with over 5 to 10 Km and power usage can be reduced from 2W to 0.025W. The E- board comes with an android app which can

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be used to pass the required messages from the user anywhere in the compound with ease.

A. Block Diagram

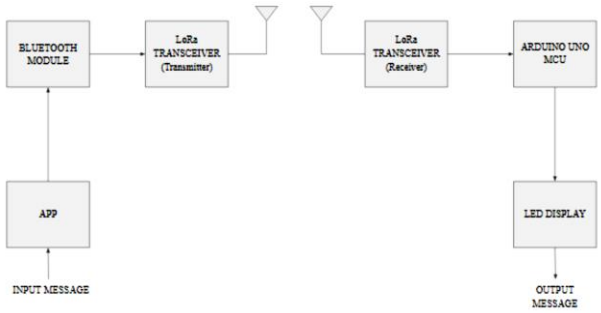

Fig. 1. Block Diagram

The message or the information to be displayed can be send from an app installed in an android mobile phone. The message to the LoRa transmitter is sent via a Bluetooth module as the mobile network and the LoRa network are both entirely different. There are two transceivers in the proposed system in which one is programmed to act as transmitter and other as a receiver.The message will be received by the receiver and is interfaced with an Arduino UNO controller to provide necessary commands to program the LED tile to display our desired output message.

IV. COMPONENTS

LED P10 Multi-Colored Outdoor Module
Arduino-UNO Module
Arduino-LoRa Transceiver
Bluetooth Module
Power supply (5V, 20A)

A. Bluetooth HC05 Module:

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/ development cycle. HC05 Bluetooth module is used as bridge to connect the app to the Lora network, i.e a bridge to send the message to LoRa Transceiver for transmitting.

B. Arduino-LoRA RA-02 AI-Tinker WIRELESS TRANSCEIVER

An Arduino-LoRA RA-02 AI-Tinker WIRELESS TRANSCEIVER has been used in the system to send messages from an authenticated authority to the main monitoring unit i.e. the notice board. It sends and receives data by wireless so that it can easily communicate from a distance. LoRa is a proprietary wireless protocol developed by Semtech for sending data to orders of kilometers, with extremely low power requirement. LoRa module works in both 868 and 900 MHz ISM bands. These low frequencies provide great penetration in possible materials (brick walls, trees, concrete), so these bands get less loss in the presence of obstacles than higher bands. The great performance of LoRa in good sensitivity, low path loss, good obstacle penetration makes LoRa a disruptive technology enabling really long range links.

C. P10 Multi-Colored LED Tile

An LED display is a flat panel display, which uses an array of light-emitting diodes as pixels for a video display. Their brightness allows them to be used outdoors where they are visible in the sun for store signs and billboards, and in recent years they have also become commonly used in destination signs on public transport vehicles, as well as variable-message signs on highways. LED displays are capable of providing general illumination in addition to visual display, as when used for stage lighting or other decorative (as opposed to informational) purposes. The E- board features on dynamic displaying of the information in the format required by the user on an LED matrix. The user posses facility for changing the color of the text displayed as per the users desire. This already gives advantage over

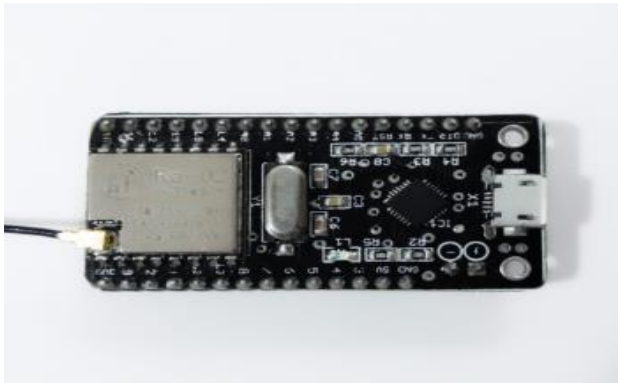

Fig. 2. Approximate Range available within the VAST Campus (Configurations Dependant)

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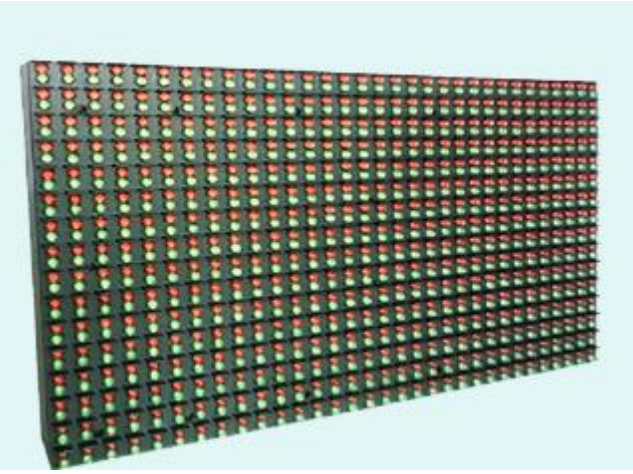

Fig. 3. P10 LED TILE FRONT VIEW

traditional notice boards. The E- board uses an LED matrix that can be very bright and eye-catching thus their information are easy to absorb due to more light per watt and can lower initial costs compared to an LCD module. It has relatively long useful life and difficult to damage with external shock. The Eboard uses several LED matrix, if damaged could be easily replaced.

V. DIFFERENT STAGES IN PRODUCT DEVELOPMENT

The development of E- Board based on LoRa Communication is divided into different stages based on study and development of various technologies incorporated into it. The first and foremost one is to study the powerful IoT communication tool LoRa. The second one would be the task of interfacing P10 LED Tile via micro-controller to initiate communication between LoRa and display module. The final stage will be the integrating all components to a casing to form the final product and start real time testing along with it adding an utility of an android app control.

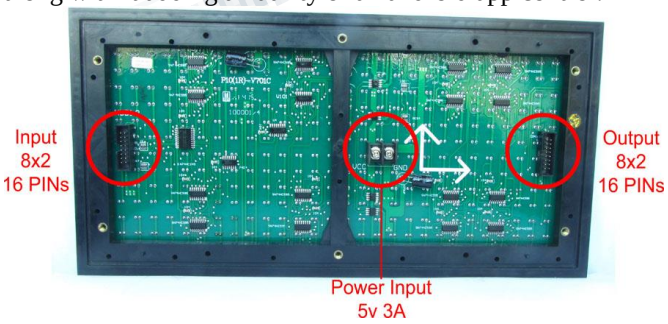

Fig. 4. Stages of Development

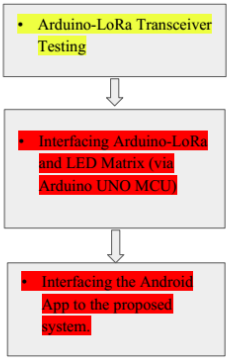

Fig. 5. P10 LED TILE BACK VIEW

VI. LORA RANGE TESTING

Lora is a wireless technology which enables the things(Internet of Things) to communicate over long distances without any repeaters. The long distances are in the order of kilometres.

When selecting wireless transceiver, the first and foremost thing that comes to our mind is the maximum range attainable, especially for low bitrate applications. In order to increase range in many existing solutions, we require repeaters, mesh topology, or use high gain massive antennas. But all of them are costly solutions and also most are restrictive by law because of the transmission power limitation imposed on our country. Another issue is that for attaining high gains and transmission power, the transmitters require more power, which requires a massive battery. LoRa is a proprietary wireless protocol developed by Semtech for sending data to orders of kilometres, with extremely low power requirement. This accounts for the introduction of the Internet of Things implementation using the LoRa technology.

As students, we at Vidya Academy of Science and Technology made an effort to estimate the maximum range attainable on our campus. The test was conducted at Vidya Academy of Science and Technology, Kerala, India. We used two LoRA Ra-02 modules to carry out the experimentation, where one of the module acts as the receiver and other as a transmitter.

VII. RANGE TEST RESULTS

The experimental procedure consists of two Arduino-LoRA RA-02 AI-Tinker Wireless Transceivers, in which one is programmed to act as a transmitter and other one as a receiver. The test grounds were initially chosen as the college

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campus, where major or central building was chosen as the site or location for placing the receiver LoRa transceiver (As the proposed LED Matrix will be there). The sender LoRa transceiver is kept at several positions and at different points in the college campus. Given transmitter is supplied with 3.3V 8MHz and contains a program which runs an infinite loop and sends packets periodically with a delay. The receiver has similar setup with program to receive any packets detected within its range.

The program library files were tweaked and with a normal voltage of 3.3V 8MHz has enabled to create a range enough to reach from various required locations in the campus (Fig 6). The following configurations were made to the LoRa Transceivers:

Spread Factor: 12
Signal Bandwidth: 62.8KHz
Coding Rate: 4/8
Antenna Used: Generic Antenna -35 dB RSSI
Transmission Power: -17dB (To obtain 1 km range)

The supply from a serial port of a laptop enables the transceivers to reach a radius of range over 200m. Several factor contribute to the signal reception and range. If the number of obstacles increases in between the sender and receiver the signal penetration strength decreases. The most suitable and ideal case is Line of Sight (LoS) which obtains maximum range. The given Table-1 and Table-2 shows the performance of LoRa with other IoT technologies. One shows the comparison between ranges available while the other shows the power usage of each one.

IoT Connectivity	TYPICAL RANGE
LoRa	5-10km (LoS Depended)
Bluetooth	20m (LoS Depended)
Wifi	50m (Indoors)
GSM	35km
ZigBee	10-50m
LTE	2km

TABLE I
LORA VS OTHERS (TYPICAL RANGE)

IoT Connectivity	MAX OUTPUT POWER
LoRa	0.025 W
Bluetooth	0.03 W
Wifi	0.1 W
GSM	2 W
ZigBee	0.025 W
LTE	0.2 W

TABLE II
LORA VS OTHERS (MAX OUTPUT POWER)

Fig. 6. Approximate Range available within the VAST Campus (Configurations Dependant)

Fig. 7. A Circular Region of Range 100 m is possible with given setting.Location-VAST

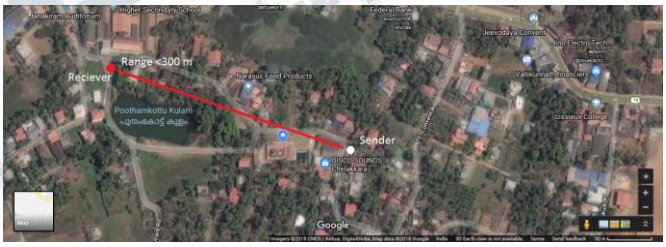

Fig. 8. A Circular Region of Range 300 m is possible with given setting. Location-Chelakkara

VIII. CONCLUSION

The proposed system works very effectively. In this paper the latest and new technology of LoRa is introduced for the advancement of the notice board and there by help in saving time and resources and making the information available instantly. The range test within the VAST campus was conducted and completed successfully with minimum power procured from a serial port of a laptop. The power could be increased to increase range and extend it upto 1 km which surpasses the range and specifications of Wifi, GSM and Zigbee modules. With these results, the ground works are completed and the data can be used for advancement of

projects. The next stages are in development and en route to be completed.

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