**Project Details**

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| **Project Title** | Digital Board Marker | |
| **Project Area of Specialization** | Artificial Intelligence | |
| **Project Start Date** | 2019-06-04 | **Project End Date** | 2020-07-31 |
| **Project Summary (less than 2500 characters)** | Digitized board marker is a size efficient, bandwidth saving lecture recording system. It can record a lecture, providing automated google search of handwritten words. Provides on the spot wiki. Lecture text notes can be generated automatically. The lecture can be named and divided into topics and subtopics automatically. According to a survey, 94% of students go for online help of recently attended lectures because they can’t fully grab the concepts. Recorded lectures as video format require so much internet bandwidth to play. In most cases, large-sized videos are difficult to handle or download. Because students mostly don’t have a huge amount of extra space available especially for the CSE students, as they already use bulky software and also students don’t have a large amount of bandwidth of internet available. The main aim of the digital board marker is to provide ease to the students of all the educational institutes. Mostly lecture systems that already exist, of different universities, provide lectures online on youtube but the problem is they need great internet bandwidth and a lot of memory to download and watch the lectures which are difficult for students especially in Pakistan. So that we provide bandwidth and storage efficient lecture system. Universities are places of knowledge production, and the economy and society are the users of this knowledge. So universities can provide ease to the student with this system. The motivation and purpose to do this project are to minimize the use of resources that are used in lecture systems nowadays working all over the world i.e. video lecture recording and streaming through the internet. The first motivation is to deal with a large amount of storage that normally video lectures take. This system is not based on video recording but on recording the writing on the board with a marker. It will record the position of the marker as the coordinates of the board where the marker touches and store it in the text file (which will later be converted and played like a video). This will take a minimum amount of database storage to store this kind of data on a website. The second motivation to do this project is to use fewer internet resources for accessing the lectures. Normally the video lectures of different institutes worldwide are very large and to download those on the system through the internet requires a large number of resources which are normally difficult for students to get and to download it in high quality even more resources are required | |
| **Project Objectives (less than 2500 characters)** | In industry most of the time, it is hard to choose areas for work which have low bandwidth internet and let’s suppose you are playing a lagging call of duty run through and your stream is buffering and stopping because of low bandwidth it’s like you are losing because of this or you are presenting something which is improved work of someone else and It requires high-quality fast internet to present it but it’s not guaranteed. In some places people try to reduce the cost of these things as much as possible but not having proper interface is the main reason for failure so we can cop up with this issue by this new system we are introducing.  In the development of the digital board marker, computer vision is used and computer vision is most vital in the field of research. Computer vision plays a great role in research work. So by improving the uses of computer vision in future work its vast area for research work.  Digital board marker mainly cover academic area the main purpose is to provide each student all the lectures with better quality and less bandwidth because in Pakistan we students face this issue the most, as we know it cannot be resolved in near future we have to work something out for this issue and that’s where this system will work it will provide an interface to all the students which have all the lectures of their respective subjects from their respective teachers which can be streamed online and downloaded for offline to play later on at very low bandwidth. It will provide all the assignment related material and lectures on the same platform to students. It is a new revolution in the academic field. | |
| **Project Implementation Method (less than 2500 characters)** | A. Position Extraction Now for optimization of video lectures, we need to find coordinates and to acquire the coordinates at every position we have to use some hardware components and a camera that can calculate the position of marker nib at every second. People may think why compression was not a choice that was because of two reasons first one is compression reduces the quality of video and the second one is it can not reduce the size as much as DBM. In other algorithms after compression, we have to try something else to make it better quality-wise and video compression algorithms can not work so accurately we can analyze that from the results we gathered.  1) Relative displacement extraction: Using stereo vision, relative displacement of the marker from middle line is attained and mapped to -100 to 100 sample points in horizontal. This method includes following sub methods.  2) Masking based on color: Masking is performed based on upper and lower limits of color. Color format is HSV for convenient manipulation while testing.  3) Morphological Processing: Erosion and dilation or opening are performed on the acquired frame to make it suitable for next processing method.  4) Boundary extraction: Contours are extracted using the given color limit and boundary is extracted by covering the biggest contour and finding its center.  B. Orientation extraction Orientation is attained using gyroscope and accelerometer sensor and transmitted using nrf24L01 LoRa transceiver. Arduino nano mainboard is used as central processing unit. I2C protocol is used to transfer data from sensor to mainboard.  C. Voice Transmission Voice data is transmitted using nrf24L01 LoRa transceiver with the range of 10 meters.  1) Voice Acquisition: Electret Condenser 4015 microphone is connected with LM386 digital amplifier that is further connected with Arduino nano. Analog to digital converter of Arduino nano converts the signal to digital and saves it into a buffer.  2) Data Transmission: Voice data saved in temporary buffer is then sent to Receiver with a unique pipe number. Data pipe is selected through which data will be transmitted and received.  3) Data Reception: Receiver module that is connected to the PC now receives the voice data through the unique pipe defined in both transmitted and receiver. After receiving voice data packet, it is decoded and sent to PC via Line-In port. | |
| **Benefits of the Project (less than 2500 characters)** | Online video lecture systems that exist nowadays are MIT open courseware, Virtual University open courseware, Lynda online courses, Udemy, etc. These are the system which is very helpful to users and can be accessed by everyone. They provide video lectures of class recording the video and audio. Almost all the systems use this same procedure of recording with a camera and microphone.  Technologies used by current systems for information storage contains the structure limitations. That is there is much less flexibility in data storage. The good quality video needs a lot of memory. It might not be a problem for the institute or web platform they are using but that might be a problem for users/students who have limited storage and limited bandwidth for watching and downloading lectures | |
| **Technical Details of Final Deliverable (less than 2500 characters)** | 1) Board Marker Marker Hardware responsible for attaining position of marker tip while teacher is writing on the board. Marker transmits position data and voice data to the central PC for further processing.  2) Controller Application Desktop Windows Forms Application that records the lecture, optimize the lecture animation and saves the lecture as a file. It offers hardware calibration and manipulation module  3) Online Lecture Player Lecture animation media player that plays animation online It provides video navigation as conventional media player does.  4) Offline Lecture Player Lecture animation player that plays animations offline, similar to online lecture player  5) Complete LMS System LMS System that provides platform for playing online lectures, assignment submission and course content management. | |
| **Final Deliverable of the Project** | HW/SW integrated system | |
| **Core Industry** | IT | |
| **Other Industries** | Education , Media , Telecommunication | |
| **Core Technology** | Artificial Intelligence(AI) | |
| **Other Technologies** | Cloud Infrastructure | |
| **Sustainable Development Goals** | Quality Education, Decent Work and Economic Growth, Industry, Innovation and Infrastructure, Responsible Consumption and Production | |

**Project Key Milestones**

| **Elapsed time in (days or weeks or month or quarter) since start of the project** | **Milestone** | **Deliverable** |
| --- | --- | --- |
| Month 1 | Orientation and Position acquisition, Voice Transmission, Battery Control Unit, Hardware Documentation | Board Marker Hardware |
| Month 2 | Position Calibration, Orientation Calibration, Filter Implementation, File generation | Controller Application |
| Month 3 | File Handling, Canvas draw, Player controls | Player Application |
| Month 4 | File Handling, Canvas draw, Player controls, Online Streaming | WebGL Player |
| Month 5 | Front-end designing (material bootstrap) | LMS Application (Front-end) |
| Month 6 | Front-end designing (angular material) | LMS Application (Front-end) |
| Month 7 | Authorization and authentication | LMS Application Back-end |
| Month 8 | Course Management | LMS Application Back-end |
| Month 9 | course lectures, notes and Assignments management | LMS Application Back-end |
| Month 10 | course marks, announcements | LMS Application Back-end |
| Month 11 | WebGL player Integration | LMS Application |
| Month 12 | Website Testing, Deployment, Documentation | Final LMS Application |

**Project Equipment Details**

| **Item Name** | **Type** | **No. of Units** | **Per Unit Cost (in Rs)** | **Total (in Rs)** |
| --- | --- | --- | --- | --- |
| High FPS Camera | Equipment | 2 | 10000 | 20000 |
| Arduino nano | Equipment | 4 | 450 | 1800 |
| nrf24l01 | Equipment | 2 | 150 | 300 |
| nrd24l01 with antenna | Equipment | 2 | 2000 | 4000 |
| White Board | Equipment | 1 | 500 | 500 |
| MPU 6050 | Equipment | 1 | 150 | 150 |
| RGB LED | Equipment | 1 | 20 | 20 |
| Li-Ion Battery | Equipment | 1 | 350 | 350 |
| Battery Control Unit | Equipment | 1 | 500 | 500 |
| Noise Control Amplifier | Equipment | 2 | 500 | 1000 |
| 3d Printed Marker Model | Equipment | 1 | 2000 | 2000 |
| Pressure Sensor | Equipment | 1 | 1000 | 1000 |
| Breadboard Material | Equipment | 4 | 200 | 800 |
| Documentation | Miscellaneous | 1 | 5000 | 5000 |
| Website Deployment | Equipment | 1 | 10000 | 10000 |
|  |  |  | **Total in (Rs)** | **47420** |