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A Survey on Head Mounted Display to Enhance the Capabilities of a Soldier

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ABSTRACT: A Soldier is required to traverse through unfamiliar territories, sometimes in low-light conditions and move in co-ordination with his team. Communication with teammates and head quarters is vital in such a scenario. We propose an HMD that will give the soldier visual directions and the ability to locate his teammates by means of a GPS module. A NoIR camera will be used to enable the soldier to have night vision. The soldier will also be able to communicate with his teammates and the head-quarters. And a live feed will be sent to the control center for better understanding of a soldier's status. This will be achieved by means of a WiFi connection. All these features are integrated into one head mounted display that is fixed onto the soldier's helmet. The device will rest on the right eye of the soldier and can be flipped upwards with ease if he doesn't feel the need to use it. A Raspberry pi will be used as the main computer to co-ordinate these activities. Such an HMD, which provides various functionalities and eliminates the need to carry many equipments can prove paramount in missions.

KEYWORDS: Augmented Reality; Mobile Computing; Image Processing.

I. INTRODUCTION

In a combat environment, having access to critical information such as location of other soldiers, precise directions in an unfamiliar territory and night vision can be the difference between life and death for a soldier. Being able to communicate with fellow soldiers and the headquarters for coordinating operations can also prove very useful. A soldier uses printed maps or digital maps on a device for directions. However these are 2D maps. A better approach would be to overlay guides over the soldiers view. This similar to how directions are shown on computer racing game. When there is low light soldiers can use a night vision camera. All the activities of a soldier should be visible to Head Quarters for coordinating attacks. For voice communication soldiers require heavy equipments. However carrying all these devices will be bulky. A soldier has to move forward and carry out actions as efficiently as possible.
An HMD shows information without distraction. Our device is able to the above tasks quite efficiently. The tasks done by the device are:

a) Navigational Guide - The soldier will be able to see directions till the destination on the HMD.
b) Communication - The soldiers can speak to each other and HQ.
c) Live Feed - HQ will be able to see action through a soldier's POV.

II. RELATED WORK

Jon Pinto [1] developed a smart uniform with multiple cameras and had networking capabilities. It used wifi to transmit audio, video and GPS information to other soldiers during patrols.
Huu-Quoc Nguyen [2] developed a surveillance system using Raspberry Pi which implemented a motion detection algorithm. A web browser is used to view live video in real time.
Rupali Ikhankar [3] made a robot for real time surveillance which used the Raspberry Pi within a network. Mjpeg streamer and Java was used to accomplish this.
Nalini Bagal [4] made a system which recieves audio and transmits it via wifi using a Pi. For remote login ssh is used, ffserver is the audio stremer and GUI is developed using Python.

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Andrew K. Barrows [5] developed a 3D Navigational system which shows the path to a pilot. Instead of showing 2D directions, showing the pilot a "tunnel" makes it very simple to follow for a pilot.
Nazmul Hossain [6] proposed a system that detects many objects in an area using SimpleCV and Pi for the purpose of surveillance. It uses the MJPG streamer for video streaming.
Virginia Menezes [7] developed a mini rover which provides real time video footage by moving around the area under observation. It uses OpenCV, Python and SSH.

III. PROPOSED SYSTEM

The proposed system is a Head Mounted Display for soldiers with navigational guide display and communication services. It is augmented reality based system that will overlay the directions on the screen that is attached to the soldier's helmet. It is helpful for soldiers as they navigate through unknown territories.

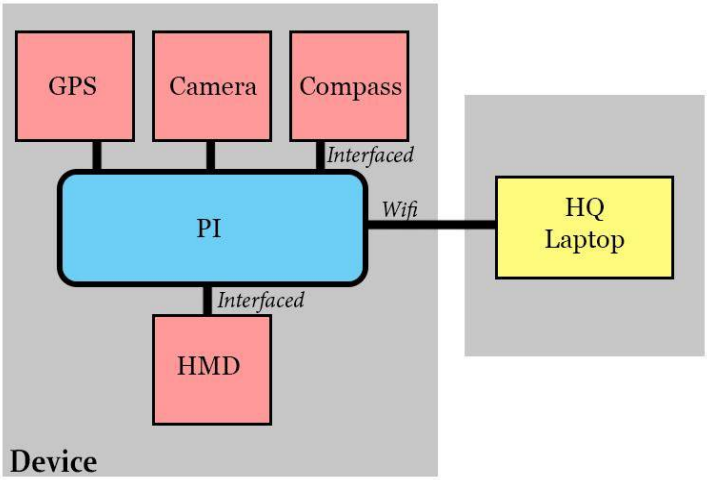

Fig. 1. System Architecture

1. Device
1. GPS:
This module is responsible for acquiring the co-ordinates of the soldier and transmitting it to the Raspberry Pi, from where it will be used to plot the current location on the map that is generated internally. The co-ordinates obtained will be transmitted to the HQ so as to display the location of every soldier on the map which will be helpful in identifying an unmarked enemy.
2. Camera:
The camera module works as the visual input for the entire system, it is used to display the live feed on the display.
3. Compass:
The compass module is responsible for acquiring the direction and physical alignment of the soldier. It is essential for calibration of the augmented map on the display due to the dynamic nature of the entire system.
4. Raspberry Pi:
The PI module is responsible for all the processing in the system. It is the core that is interfaced to every other module as well as the Head Quarters.
5. HMD:
This is the visual output provided by the system. It is mounted on the helmet of the soldier and can be set up as to align over the eye of the soldier. A 2.5" TFT display with an Aspheric lens will be used.

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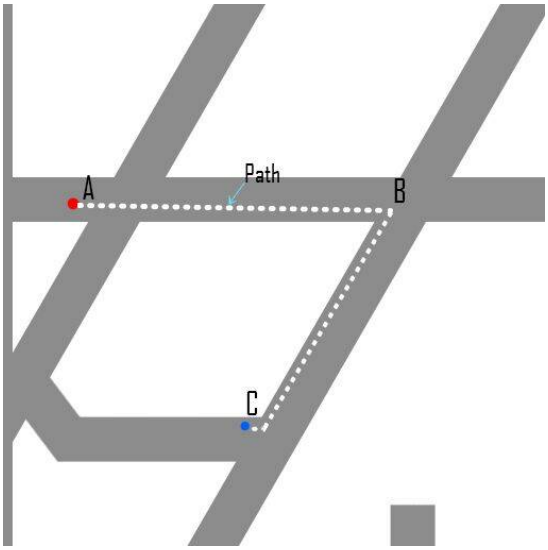
2. HQ Laptop:

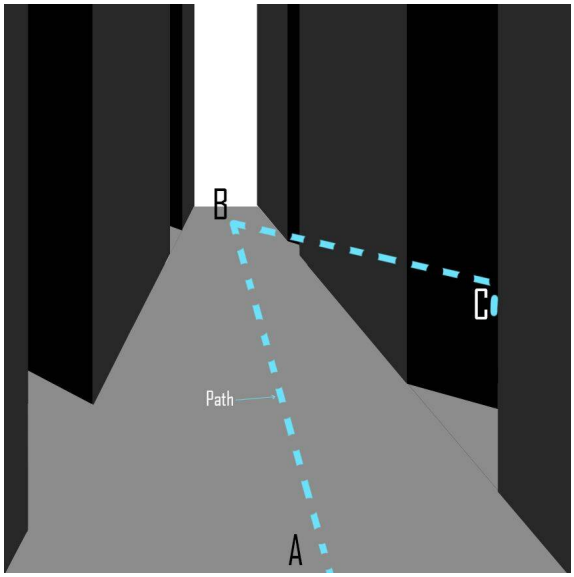
This component acts as the central repository for all the data transmitted by the Raspberry PI and also as the common interface between multiple head mounted displays for enabling audio and visual communication.

Algorithm for displaying 3D navigational guide:

1. Take the current location via GPS and the destination from the user.
2. Generate 2D map by using Google Maps API
3. Convert each of the the 2D lengths to a 3D projection from the perspective of user.
4. Overlay this 3D directions on top of the live feed.



2D Map



The view for the user

The figures show how the 2D map will be converted to 3D and shown to the user

IV. CONCLUSION AND FUTURE WORK

The HMD system with a few tweaks can be used for various purposes other than those that are military oriented. AR based first person shooter gaming, military training purposes, media and entertainment being a few of them. Using advanced modules can result in better quality of pictures which will enable better visual capabilities than the current one, using better chips and efficient components will enable better portability. Improves in the GPS module can improve accuracy of the device and make it more efficient. The scope is endless considering the upcoming studies related to augmented reality today.

The HMD mentioned above is a low cost, work specific device that will thus be highly efficient for soldiers deployed in unknown terrains and also to have an active continuous communication link with the headquarters that will enable them to request for backup with minimal effort and to transmit live feed as well as important combat related details.

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