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HELMET BASED CONCUSSION DETECTION AND DIAGNOSIS FOR PLAYERS USING MESH NETWORK

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Abstract - *This project presents a concept approach towards the detection of level of effect to head, in a helmet of football players and appreciate the severity of attack through analyzing the received data from the helmet. Concussion alters the brain functionality when occurred for a greater number of iterations in accidents. It happens when a sudden blow is introduced to the head at a fall, hit or could be worse in case of accidents. Concussions is a kind of traumatic brain injury which has been a notorious trouble on sports, being a significant cause for player suicides and retirements due to Chronic Traumatic Encephalopathy (CTE) from their playing careers. Because concussions are not visible on X-rays or CT scans, attempts to detect concussions have been challenging. A force sensor is an instrument that predicts impact and accordingly mitigates injury. The system presented here detects the amount of impact caused during a hit for a football sportsman who is most susceptible for head injuries. In this project, to design a prototype model helmet to measure the impact of a hit when a player head comes across a hit. This system has two helmets which are considered as slaves in wireless mesh network and communicates to the master by sending essential data about the hit through wireless communication. It will be helpful to take immediate actions to decrease the serious effects of hit. This system will monitor the players' status from distance through API website and also in android application which is self-developed for this purpose.*

Key Words: Concussion, Helmet, Flux sensor, Threshold value, Diagnosis, Wi-Fi Device.

1. INTRODUCTION

Soccer is regarded as one of the oldest sports with its first formal set of rules being created in1848 in England. It is now the world's most favorable sport, with over 250 million participating and more than 1.4 billion having an interest. On a global scale, soccer and related businesses are worth more than $250 billion annually and they repeat to gain more popularity. Unlike other sports, soccer needs minimal equipment and little to no physical contact enabling people of different ages and economic class to participate. However, with no specific training, the chance of injury can increase particularly in skills that require accurate form and techniques, one such being heading a ball. In recent decades, concussion has been a big concern within sports, mainly in full contact sports, such as American football and rugby. Despite soccer having minimal player-to-player contact, like American football and rugby, the approach of heading whereby players intentionally use their head to impact the ball has been the center of research regarding concussion in soccer. On general, a professional soccer player will make head to ball contact 6–7 times in a match and, in the midfield positions, a high percentage of heading is linear as players return the ball from the path it came. Kirkwall and Garrett stress the necessary of contracting the neck muscles to stabiles the head during a soccer header. An unready head increases the ball mass-contact mass ratio and raise of the risk of injury due to the force of the ball striking the head and accelerating it backward. This suggests that higher neck strength is a key factor can decrease the seriousness of head impacts. A range of literature has analyzed this association and very recently a novel testing device to assess the eject of neck strength on danger of concussion has been developed.

1.1 OBJECTIVE

- To avoid serious health illness after a head hit i.e., concussion especially for football players who are more susceptible for concussions.
- To implement an efficient system to detect and diagnose the status and condition of the concussion as soon as possible to get immediate treatment if needed.
- To ensure safety for the players against such common challenges that prevail in sports.

2. LITERATURE REVIEW

[1] 'Automatic Classification of Athletes with Residual Functional Deficits under Concussion according by EEG Signal Using SVM 'by Cheng Cao, Tutwiler R.L, Solomonov S, aims at detection of concussion based on EEG signal, using SVM in 2018. [2] 'Detecting Concussion Impairment with Radar Using Gait Analysis Techniques' by Palmer J.W, Bing K.F, Sharma A.C, Greener E.F have been developed for sensing concussion by using Gait analysis, it aims at

comparison of Gait relative to a person before and after the hit in 2017.[3] D "Intelligent " Single Event Head Impact by Bartsch, A.J., Samorezov, S., Benzel, E.C., Miele, V.J. and Brett, focuses on the ADXL375 digital accelerometer design which features high bandwidth and high accuracy compared to other MEMs accelerometers. It is very low power and contains features that allow for a high level of autonomy, including digital outputs.[4] Estimation of angular acceleration for a solid body using linear accelerometers by Padgaonkar, A. J., Krieger, K. W., King, A. I., uses multiple linear accelerometers to calculate rotational acceleration is a proven method for high accuracy and is commonly done in crash test dummy design where the head can be assumed a rigid body.[5] On the value and placement of accelerometers for angular velocity and acceleration determination by Zappa, B., Legnani, G., van den Bogert, A.J., Adamini, R consisting of combination of four, three-axis linear accelerometers located at known noncoplanar points provides the necessary and sufficient input data for the measurement .

3. ARCHITECTURE DIAGRAM:

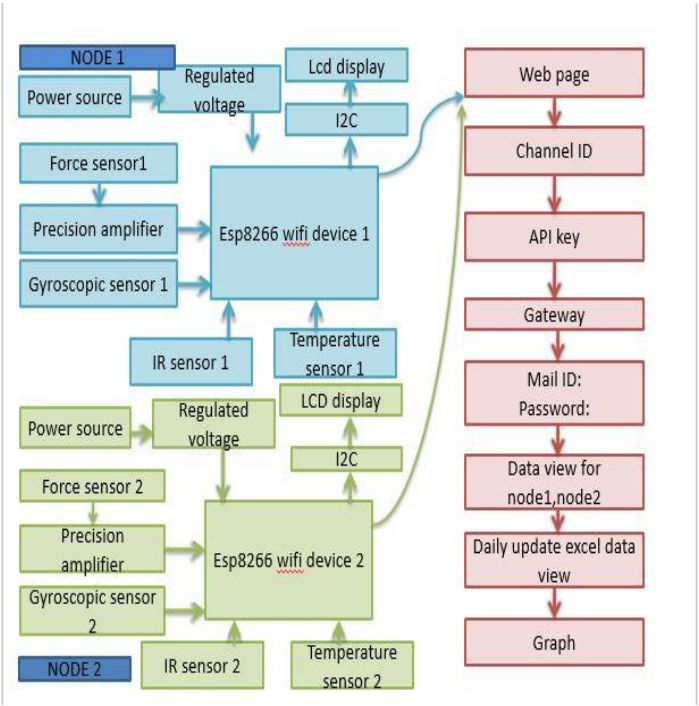


Fig 1: Architecture diagram for concussion detection

4. METHODOLOGY

The force sensor, used in this system measures the intensity of the hit and gives an output in terms of "g" Force based on the threshold set. The Measured "g" will help for further diagnosis of the patient. This diagnosis helps in the place where a person cannot move his body and is in critical condition. The master (website) get data from sensor it resolution is 2 ^10 resolution = 1024 samples data and it stored in cloud data base in excel format which can be monitored month wise and also the information will be represented in graph format for better analysis. This system also uses temperature sensor to monitor the body temperature of the player. IR sensor is used to detect the presence of player's head in the helmet. Two helmets are given with two separate channel IDs for proper communication and API key is used for secured transmission of data from slaves to master nodes in wireless mesh network. Gyroscope sensor is used to sense the position of the head and to detect the tilt of the head during a head hit, and such sensed information will be sent to the website and android application (self-developed) for immediate analysis and further treatment.

5. EXPERIMENTAL SETUP

5.1 HELMET:

A board that combines the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is previously connect with wire on the chip, a hardware reset button, wifi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board.

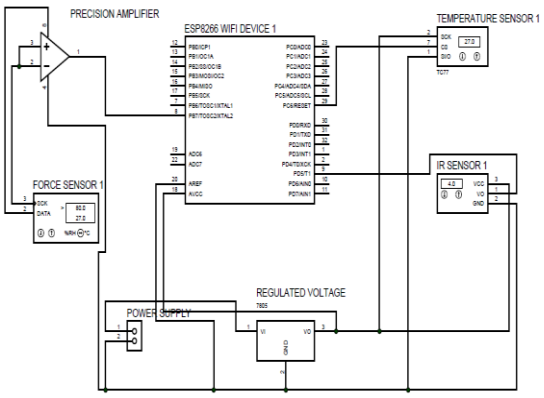


Fig 2: Circuit diagram for Node 1

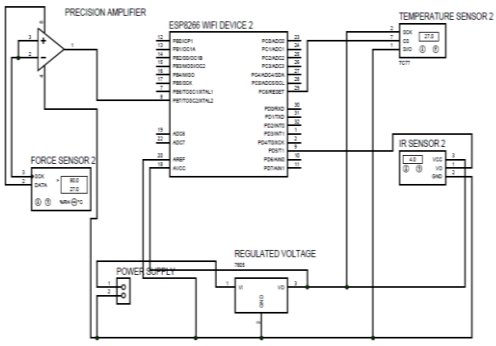


Fig 3: Circuit diagram for Node 2

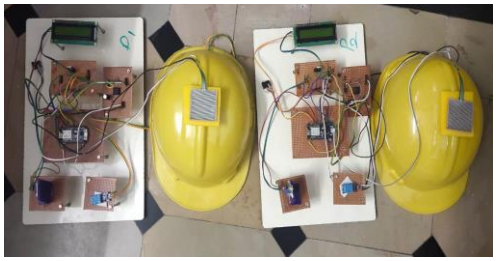
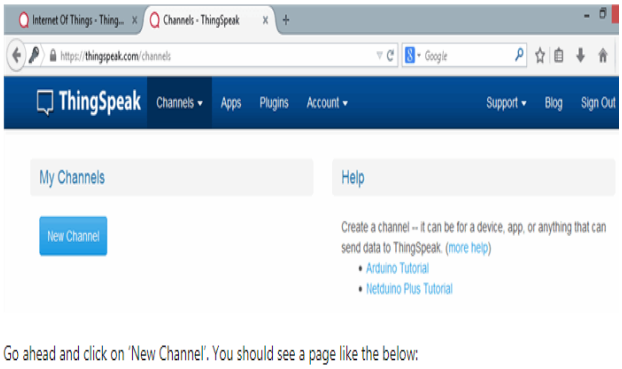


Fig 4: Experimental setup of Node 1 & Node 2

5.2 THINGSPEAK WEBPAGE:

Thing Speak is a platform providing various services exclusively targeted for building IoT applications. It offers the potential of real-time data collection, visualizing the collected information in the form of charts, ability to create plugins and apps for connecting with web services, social network and other APIs.



Go ahead and click on 'New Channel'. You should see a page like the below:

Fig 5: Thingspeak webpage

6. RESULTS

The output from the helmet node1 and node2 is connected to Think speak webpage software provides a display of the results of humidity, temperature, body impact.

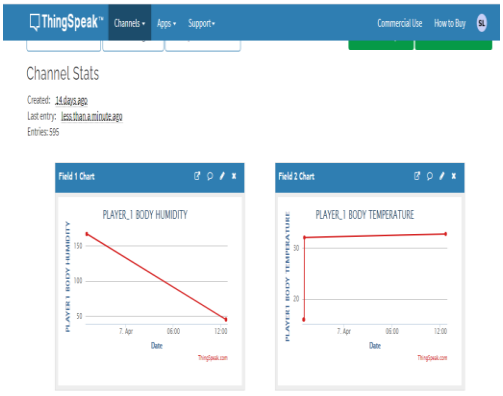


Fig 6: Humidity & Temperature of node 1

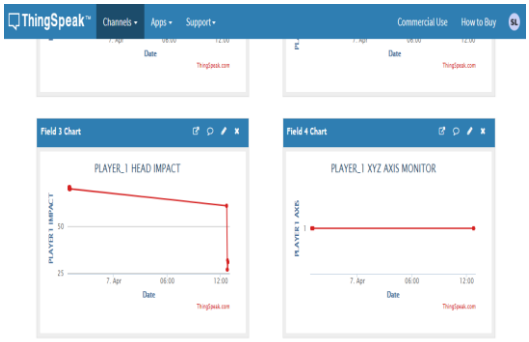


Fig 7: Head impact & monitoring of node 1

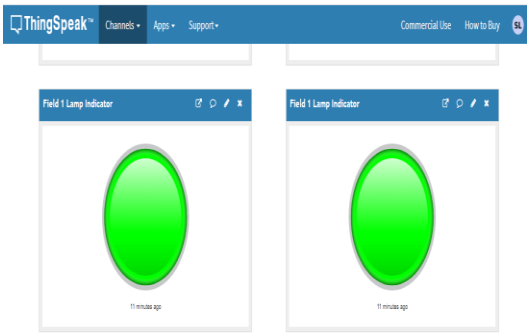


Fig 8: Indication of their body impact of node 1

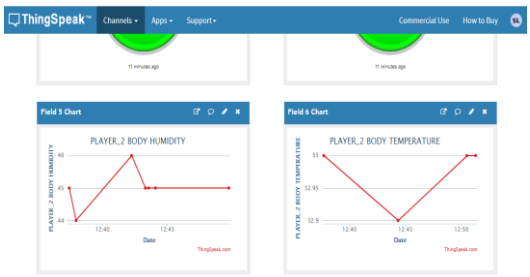


Fig 9: Humidity & Temperature of node 2

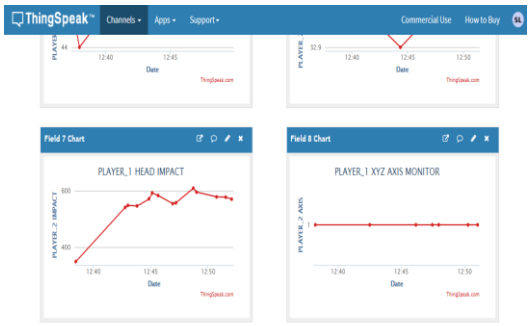


Fig 10: Head impact & monitoring of node 2

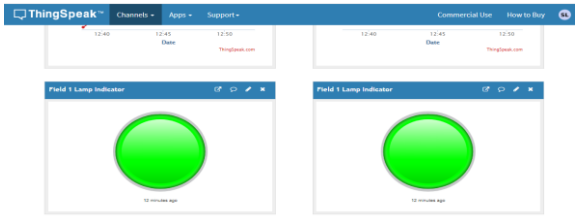


FIG 11: Indication of their body impact of node 2

7. CONCLUSION

The project of diagnose concussion detection using mesh network Measurements was designed and implemented successfully. In this project collected by force monitors provided real-time information to evaluate player exposure but did not have the requisite sensitivity to concussion. Proper interpretation of early reported head-impact kinematics across sport, and place may inform future research and allow staff clinicians functioning on the sidelines to monitor athletes.

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