Precision Livestock Farming (PLF)

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Code & Documentation

Abstract :

Broiler chickens are prone to mass casualty and disease outbreaks with no significant symptoms leading to huge economic loss for the farmers. Moreover, they are made to grow fast, oftentimes unable to support their own weight causing leg disorders and paralysis. This poster presents a novel method that monitors the mobility, distribution (using images from camera processed with trained YOLO and SORT algorithm) and feeding behaviour (using sound analysis) to estimate the welfare of the fowls while providing suitable habitat for growth (with environmental sensor and ac appliances). This results in increased profit for the farmers. We also found the broiler to prefer high temperatures and humidity, and good ventilation a must to curb the effects of methane and ammonia gases produced from the excreta of the chickens.

Poultry is one of the contributing areas for the growing problem of antimicrobial resistance in Nepal. Our project can also help prevent outbreak of diseases and introduce timely intervention that can minimise unnecessary antibiotic administration.

Objectives :

1. Create feasible environment for the growth & minimize disease outbreaks in broiler chicken
2. Raise business profile of poultry farmers
3. Determine health condition with fowl behaviour analysis & alert farmers when needed
4. Intervene excessive use of antibiotics

I. Introduction:

Precision Livestock Farming (PLF) uses various advanced technologies to monitor and understand animal behaviour in order to optimize their contribution to the livestock. Our prototype monitors broiler chickens in the poultry using camera, microphone and various environmental sensors to examine the fowl behaviour (feeding, mobility, distribution, etc) which has been correlated to the well being and sound health of the broiler variety.

Camera is used to track each chicken for their distribution and mobility index. Dense distribution implies ventilation failures, illumination changes and feeding problems and low mobility index reveals locomotive issues, lameness (paralysis) or leg disorders. Microphone is used to detect peck counts and quantitatively estimate feeding behaviour. Other sensors (temperature, humidity, air quality and light sensor) are used to maintain suitable habitat, assisted with heater, fan, light bulbs and other connected ac appliances. High temperature and humidity in poultry farm means lower mortality, ramified growth and feed conversion. Whereas, excessive ammonia gas can severely affect the health (such as cause bacterial respiratory infection, reductions in body weight, etc) of chickens which we detect and counteract with air quality sensor and ventilation respectively. Finally, our prototype includes a mobile app that streams the status of the farm and notifies the farmer in critical situations.

II. Methodology:

The diagram below shows the external connection between different equipment used in the prototype. Camera and microphone are connected to raspberry pi by wires and mobile is connected to hotspot generated by raspberry pi. The camera and microphone generate data (images & audio) which is then processed by raspberry pi and result is pushed to Arduino with UART. Arduino is further connected to environmental sensor (Temperature and Humidity sensor, Ammonia sensor & LDR) which is also responsible for deciding whether or not to switch appropriate ac appliance through ac control board. All of the data available to Arduino is sent to atmega32 for display and alert system using software serial.

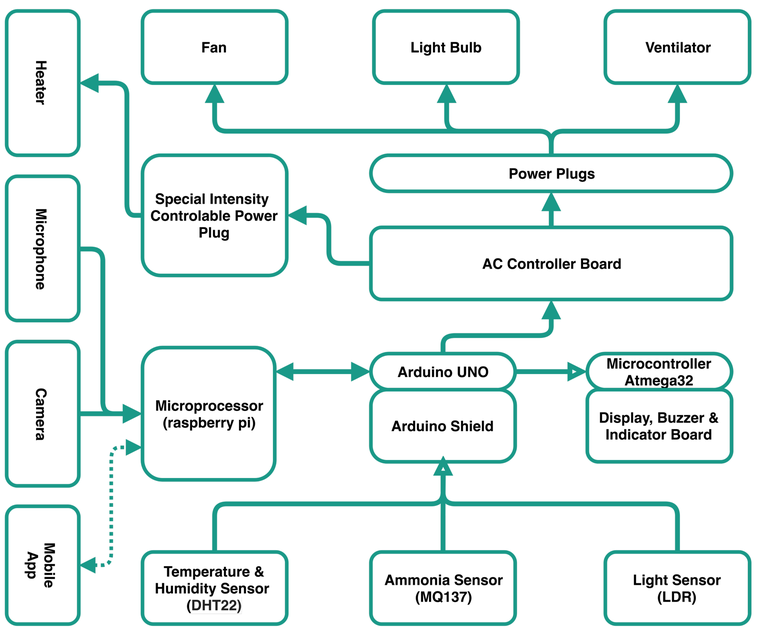

Fig: Physical architecture of prototype

Fig: Communication between Raspberry pi, Arduino and Atmega32

AC controller board consists of optocouplers (which isolates sensitive dc circuits from dangerous ac by using light), relays to switch ac appliances and a triac to generates variable ac power by changing firing angle (for Special Intensity Controllable Power Plug).

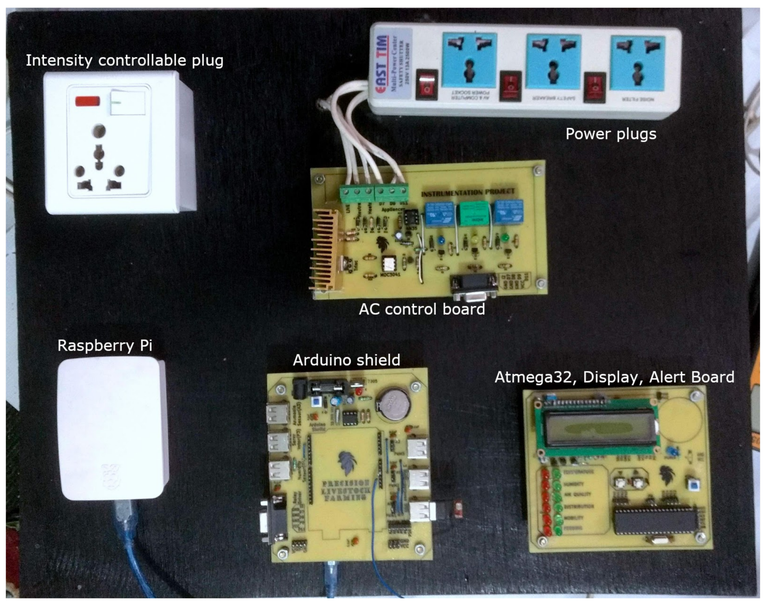

Fig: Picture of Prototype

Image processing:

Images from camera progress through trained YOLO architecture trained on broiler image dataset detects the fowl and SORT (simple online real time tracker) identifies & tracks each fowl for the mobility and distribution index.

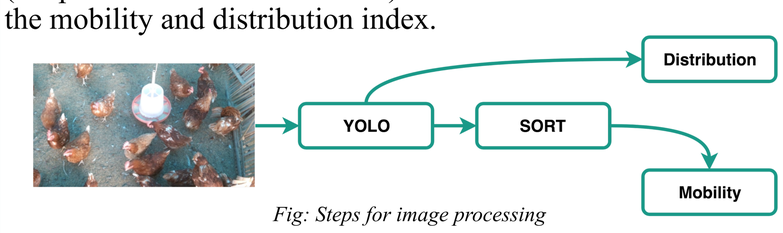

Fig: Steps for image processing

Sound Analysis:

Microphone under the feeder captures peck sound which is filtered (with bandpass filter with cutoff frequencies of 2 and 5 kHz), classified (based on energy) and enumerated to estimate the feeding amount.

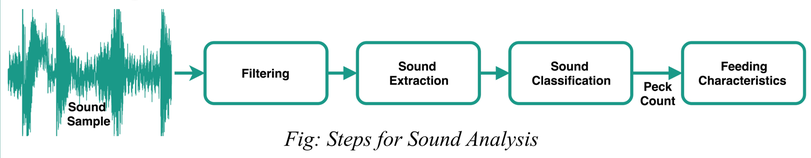

Fig: Steps for Sound Analysis

Mobile Application:

Our prototype includes a farmer friendly mobile application that connects to the internet and is powerful enough for remote controlling of the farm. With the help of flask, a server is setup at the raspberry pi which cooperates with the app. Raspberry pi sends the data or command received, down the chain line (Arduino & atmega32).

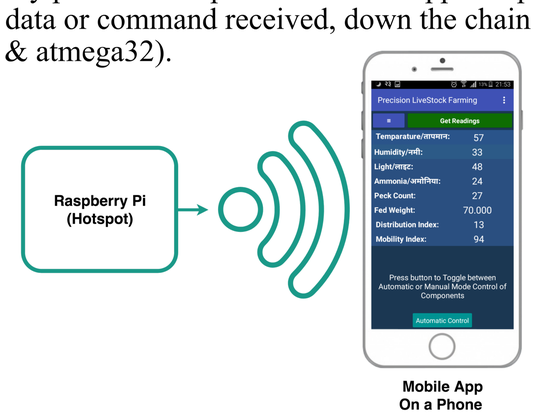

Fig: Communication between Raspberry Pi and Mobile app

III. Result and Analysis:

The image from camera passed through the trained YOLO and SORT tracks each chicken fairly well with unique ID.

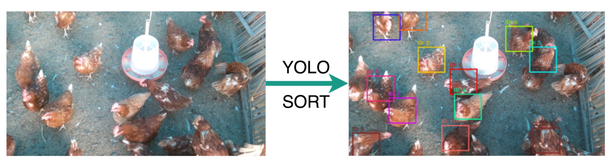

Fig: Communication between Raspberry Pi and Mobile app

The microphone is subjected to noisy environment which is filtered and enveloped. The envelope is fuzzy so moving average is applied, then high peaks are identified successfully. Note: all peaks aren't pecks so pecks are classified on the basis of energy. Feeding behaviour is the above illustrated graph of the amount of food fed vs the time of the day. The two peaks indicate high feeding activity of broilers at the time but this is biased because the feeder were refilled at the moment.

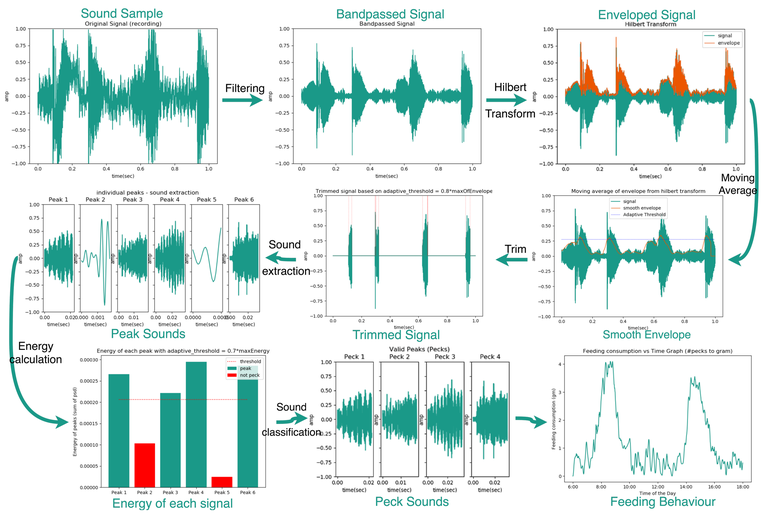

Fig: Sound Analysis step by step results

In the home screen of the mobile app, data (temperature, humidity, ammonia, feed amount, mobility, distribution, light, and more) are fetched continuously from raspberry pi. The side bar allows users to change the mode. Ac appliances such as heater, fan, light and ventilation are switched manually from the manual mode control but we can set the switch to the automatic mode too. For heater we were able to control the intensity using special power controllable plug. Finally, we observe the resulting progressive graph of the live data stream.

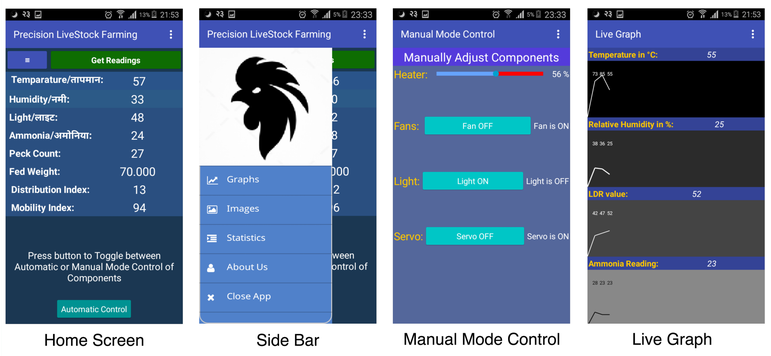

Fig: Mobile app screenshots

IV. Conclusion:

The poultry industry makes up a significant portion in meeting the ever increasing demand of meat across the country. But the business is not without risk as chickens are prone to sudden and unexpected mass deaths. In this poster we present an approach to counterattack it by promoting the health of the broiler chicken and raise the business profile of the farmers at the same time. We do this by implementing our prototype that provides a suitable environment for growth and minimize disease outbreak by analysis of fowl behaviour. We performed sound analysis for feeding behaviour, image processing and neural net to estimate distribution and mobility of the broiler. Additionally, we used feedback based temperature, humidity and air quality control to achieve our goal.

V. References:

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