SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: FA1308
STSM title: Small boluses and data acquisition integration for small ruminants
STSM start and end date: 28/01/2018 to 02/02/2018
Grantee name: Carles Ferrer Ramis (Application number #39986)

PURPOSE OF THE STSM/

This STSM aimed to coordinate the activities between the "Universitat Autònoma de Barcelona" / Autonomous University of Barcelona (UAB) and the University of Strathclyde, Glasgow (UoS) in relation with the technologic development aspects inside the Incubator Grant on "Sensors for Small Ruminants" which is running inside the Dairy Care Cost Action.

Since several years ago UAB is developing small boluses for small ruminants they permit to monitor ruminal parameters like temperature, movement, etc. and they could be retained by sheeps and goats' rumen for a large period of time. This research activity has been a collaboration between the UAB's Veterinarian Faculty and UAB's School of Engineering combining experiences in animal nutrition and precision livestock farming with microelectronics and hardware IoT development respectively.

Complementary UoS has a large experience in data analysis applied to precision livestock farming applications within data acquisition of external sensors like accelerometers placed in closer to the mouth or in collars on dairy and meat cows. These sensors permit to determine the daily cow activity and to prevent potential diseases.

The main expected output was to complement the experiences between both Universities and to coordinate their activities before the deployment of a pilot experience to install the monitoring small boluses developed by UAB in different participants of different countries. Additionally, due to complementary experience, it was expected to analyse possible new applications of ruminal small boluses, other external sensing systems and data acquisition for livestock farming sector.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

During the stage at the University of Strathclyde in Glasgow several meeting took place between Prof. Carles Ferrer, UAB, Dr.Craig Michi, UoS and Dr. Andrew Hamilton, UoS among other people of the UoS were the research experience in University of Strathclyde and Universitat Autònoma de Barcelona in ruminant livestock farming electronic circuitry development and data acquisition ones were detailed. Consequently, their complementariness was studied for their applicability to different ruminant species (cows, sheeps and goats) and how they could be realized in short and mid-term.

UAB presented its experience in small boluses electronic platforms development for sensing ruminal temperature and acceleration realized in the framework a Spanish National project. Technological developments were described including the hardware platform design, the wireless communications aspects including antennas and assembling and packaging solutions to achieve the final objective of a small bolus with less than 10 cm long and 2 cm of dimeter that matches the small ruminant's constraints to swallow it. The results of the in vivo test obtained at the UAB farm facilities were later shown. Several ruminal boluses were implanted in dairy ewes for the measurement of the ruminal temperature and their comparison with the food guideline of the same animals finding a total correlation between them. Just now, the UAB is producing a short series of boluses they will be use in a pilot experience for the Dairy Care Integration Grant previously mentioned were several European Universities and Research labs will test the same technology in different farm exploitation scenarios and small ruminant species.

In other hand, the UoS presented their data acquisition experience on meat and dairy cows using external accelerators placed in different positions on the cow (mouth and collar) to determine the cow activity (eating, rumination and general activity). On the contrary, they neither experienced their research developments with small ruminants nor with ruminant boluses. Anyway, they have large experience analysing the data obtained during large period of time in order to determine potential abnormal situations in the livestock farming as well as with the electronic and RF communication at low frequency.

Finally, the rest of the stage in Glasgow were devoted to analysing potential future common activities they permit to increase the scientific relevancy, or the results obtained until now in small ruminants in Barcelona and cows in Glasgow by defining a new pilot experiences to be realized in Glasgow and Barcelona.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

In that meetings the main results obtained were related to stablish a mutual knowledge of the research activities related with the both Universities in ruminant's precision livestock farming as has been described in previous section.

In addition, we planned a draft of possible collaboration between the two universities in order to bring together the research that will allow them to extend the use of ruminal bolus for small ruminants as it does in certain cases for the cows.

So, after the meeting was left pending that the people of the UoS will contact an animal nutritionist Dr. Nick Jonson of the University of Glasgow, which could access to small ruminants in Scottish farms to have not only the participation of engineers of Glasgow but also of animalists as it happens in Barcelona in the UAB. That will permit to define a new pilot extension of the usage of UAB's boluses in combination with external sensors to compare both technologies results. Unfortunately, the meeting with the UoG was not possible during the week in mentioned by problems of agenda of Dr. Johnson but we expected to involve also them in the new pilot experiment.

FUTURE COLLABORATIONS (if applicable)

After the stage, two different approaches have been analysed and:

i) To realize a pilot involving UAB' ruminants research group from Veterinarian Faculty and Integrated Circuits and Systems Design from Engineering School and UoS' people of Electronics Engineering dept. and animal nutritionist people form the University of Glasgow. The

idea is to correlate the external and the internal sensors with in the experience in meat and dairy sheeps from both universities in Barcelona and Glasgow.

ii) Additional in a mid-term approach it will be analysed the possibility to ask a pilot project at the IoF2020 program. This programme is part of the EU-funded IoT Large-Scale Pilots Programme (LSP) comprises a total of eight innovation consortia, working hand in hand to foster the take up of Internet of Things (IoT) in industrial sectors in Europe and beyond. By addressing both societal and industrial challenges through IoT, the LSP seeks to improve the competitiveness of Europe at the global level, while increasing the quality of life of its citizens. IoF2020 is part of the LSP and collaborates closely with its sister projects to achieving the programme's objectives. Below you can find more information on the other LSP innovation consortia. In particular, Precision Livestock Farming (PLF) is key to satisfy the increasing world-wide demand for good quality animal products in combination with responsible farming. To reduce environmental impact, diminish resource use and increase animal welfare while at the same time intensifying productivity is the imminent challenge faced by the dairy sector.

The decision was to prepare paths proposals in order to make a first activity of collaboration with the current technology within the framework of the Incubator Grant and submit below a proposal of integration with the platform IoF2020 since this provides all the vertical integration with the European big data standard Fiware which the UAB has previous training experience and the UoS is participating as a one of the seventy IoF2020 partners and they now the rest of technological IoT environment. This is offered by the program to any new agricultural and farming technology to integrate easily with the communication and bigdata framework to accelerate its transference to the market in order to be used by the sector stakeholders.